

THUNDER BAY BEACHES, 1984

April, 1986

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Ministry
of the
Environment

W.M. VROOMAN, Director
Northwestern Region

THUNDER BAY BEACHES, 1984

Factors Affecting the Bacteriological
Water Quality of Selected Beaches
In the Thunder Bay Area

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MINISTRY OF THE ENVIRONMENT
Northwestern Region
Thunder Bay, Ontario
April, 1986

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SUMMARY

During the summer of 1983, three beaches (Chippewa, Lakeview, and Hazelwood) close to the City of Thunder Bay were placarded for the first time ever. In 1984, the Ministry of the Environment (MOE) initiated a program to determine the factors causing the high fecal coliform levels at these beaches. In addition, several other local beaches were included in this monitoring program.

A sanitary survey was conducted at each beach prior to the bathing season. Both "beach" and "off-beach" sampling stations were established. Samples were collected by MOE and Lakehead Region Conservation Authority staff. Factors such as rainfall, wind direction and intensity, wave action, cloud cover, water temperature and bather loading were monitored. Samples were analyzed for a variety of bacterial parameters and turbidity.

Stormwater run-off was found to be the primary factor causing elevated fecal coliform levels at Chippewa Beach, Lakeview Beach and Sandy Cove Beach. Rainfall appeared to affect the water quality at Lakeview Beach less than Chippewa Beach.

The primary factor affecting water quality at Hazelwood Beach was bather loading. In 1984, a childrens' day-camp program was established at this beach. Low levels of indicator bacteria were observed in morning samples when bathers were absent. However, high levels of Pseudomonas aeruginosa, fecal coliforms, and E.coli were intermittently observed in the afternoon when bathers were present.

Chippewa Beach was placarded twice by The Medical Officer of Health during the summer of 1984.

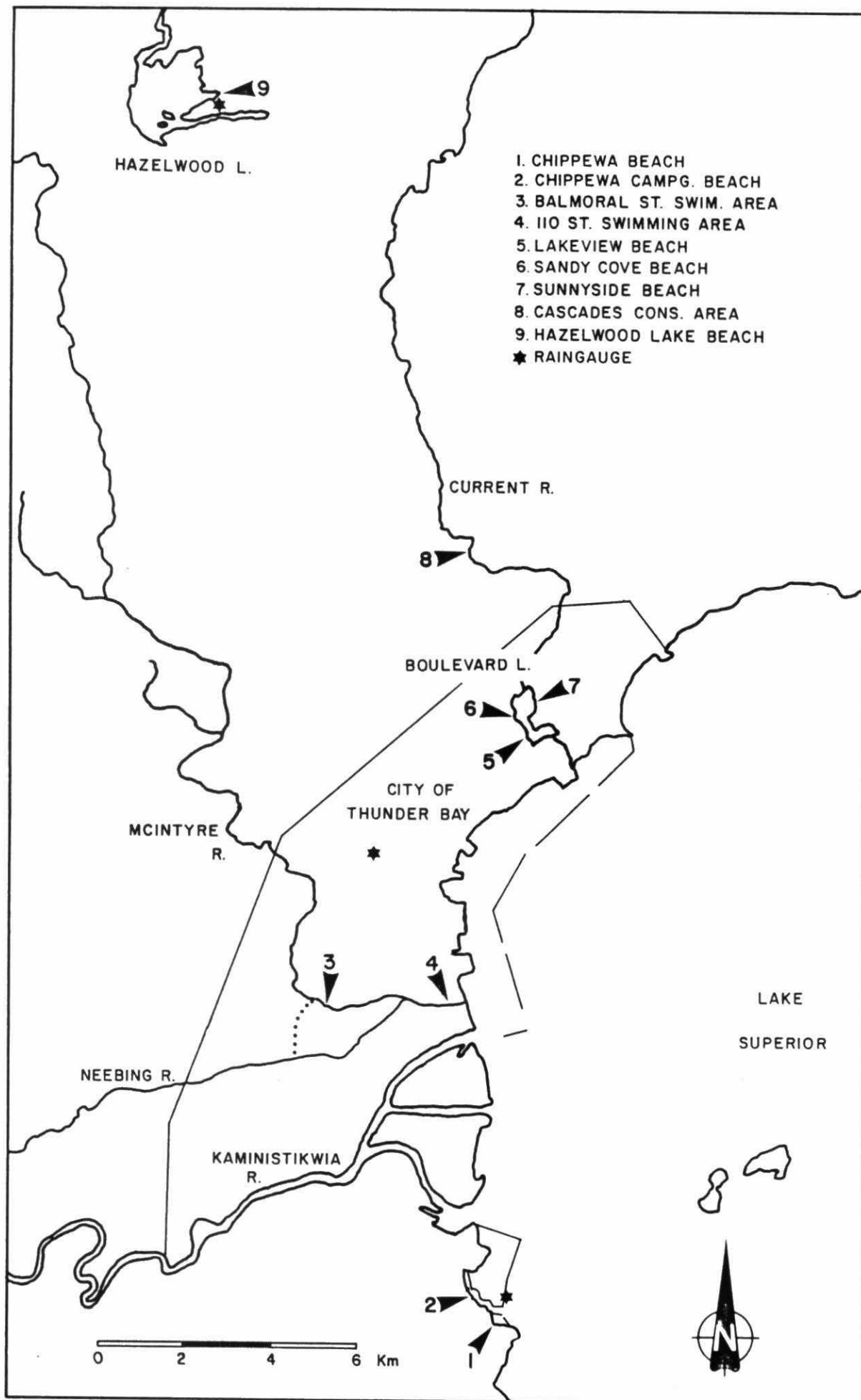


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INTRODUCTION

During the summer of 1983, an unprecedented number of bathing beaches in Ontario were placarded because of elevated levels of fecal coliform bacteria. While the vast majority of the placarded beaches were located in Southern Ontario, Northwestern Ontario also contained a number of placarded beaches. In the summer of 1983, three beaches close to or within the limits of the City of Thunder Bay were placarded for the first time ever. The three placarded beaches were Chippewa Beach at Chippewa Park, Lakeview Beach at Boulevard Lake Park and Hazelwood Beach at Hazelwood Lake Conservation Area. An earlier report (5) summarized the bacteriological data available from the beach surveys conducted in 1983 by the Thunder Bay District Health Unit (TBDHU) and the Lakehead Region Conservation Authority (LRCA)

The rash of Ontario beaches that were placarded in 1983 led to a great deal of publicity. As a result, the Ministry of the Environment (MOE) initiated both a review of the recreational water quality standards and a province-wide program to determine the factors causing the elevated fecal coliform levels in the bathing area water at the placarded beaches. In the Northwestern Region, as part of the province-wide program, the MOE initiated an investigation into the factors causing the high fecal coliform levels that were observed in 1983 at the three, local, placarded beaches.

In Ontario, the Ministry of Health is responsible for determining the suitability of the water quality in the bathing area for bathing. The MOE is responsible for monitoring the off-beach pollution sources that may be impacting the bathing area. The Ministry of Health collects samples from the bathing area while the Ministry of the Environment collects samples from the off-beach sources. This system yields two different data bases. Since it was unlikely that a single source such as a raw sewage outfall, for example, was responsible for causing the elevated levels of fecal coliform bacteria at the local placarded beaches, the fecal coliform levels in the various sources were expected to be relatively low. Therefore, the factors causing the high levels were expected to be somewhat difficult to pinpoint. For this reason,

it was necessary that both the bathing area samples and the off-beach samples be directly comparable so that the impact of the various factors could be assessed more easily. Thus, for the 1984 bathing season only, the MOE in the Northwestern Region assumed the responsibility for the collection and analysis of both the routine beach samples and the off-beach samples at the local placarded beaches. This would combine the two data bases and eliminate the potential variation caused by different samplers, sampling techniques, sampling times and laboratories using different analytical methods, etc. All bacteriological results were reported to the Medical Officer of Health (MOH) who was solely responsible for the decision to placard a given beach.

In addition to the placarded beaches noted above, the MOE also assumed the responsibility for the routine monitoring of several other bathing areas in or near the City of Thunder Bay. This latter monitoring provided not only uniform analytical results for the local beaches but also several external controls against which the problem beaches could be compared.

GENERAL METHODS

The overall survey design for the 1984 Beach Monitoring Program conducted by the MOE, Northwestern Region, was based on the following two documents:

1. Scientific Criteria for Microbiological Standards for Recreational Waters (Draft). Ministry of the Environment, Hazardous Contaminants and Standards Branch, February, 1984.
2. Procedures for Determining the Status of Bathing Beaches (Draft). Public Health Resource Service, Public Health Branch, Ontario Ministry of Health, April, 1984.

Unfortunately, the second document was not available until early July, 1984, well after the beach study had begun. Indeed, both documents were available only as working drafts so the procedures and guidelines contained in them had not received final approval. As a consequence, several of the procedures used deviated slightly from those outlined in the drafts.

The following beaches or potential bathing areas were included in the 1984 Beach Monitoring Program:

1. Chippewa Park: Chippewa Beach
: Chippewa Campground Beach
2. Boulevard Lake Park: Lakeview Beach
: Sunnyside Beach
: Sandy Cove Beach
3. Hazelwood Lake Conservation Area: Hazelwood Beach
4. Cascades Conservation Area: Cascades Swimming Area
5. Neebing-McIntyre Floodway: Neebing-McIntyre "Beach"
: 110th Avenue Bridge Swimming Area

In Northwestern Ontario, the bathing season is shorter than in Southern Ontario and is generally considered to begin around mid-June

and continue until late August. This period may fluctuate somewhat, depending upon the weather, but often extends only 10 or 11 weeks each summer.

1. FIELD METHODS

1.1 SANITARY SURVEY

Prior to the start of the formal bathing season, MOE staff conducted a sanitary survey of each beach or bathing area. Detailed maps and descriptions of each beach were prepared. All outfalls or potential outfalls that might have an impact on the water quality of the bathing area were identified and marked on the maps. Each outfall was characterized by type (sewer, storm, drain, ditch, etc.), nature of the discharge, flow rate, etc. During the final week of May, 1984, bacteriological samples were collected at each outfall. Based on these results and the topography of the beach and environs, locations for sampling stations were established.

1.2 SAMPLING STATIONS

The sampling stations used in the 1984 Beach Monitoring Program were divided into two distinct categories: beach sampling stations and off-beach sampling stations. All station locations were marked on the various maps and were assigned codes for easy reference. A detailed description of the location of each sampling station is available on request.

1.2.1 Beach Stations

Sampling stations that were located within the boundaries of the bathing area were called 'beach stations'. These stations were used for the routine monitoring of the bacteriological water quality of the bathing area throughout the bathing season. Typically, three beach stations were established in each bathing area. This number was adjusted up or down depending upon the length of the shoreline, expected water quality or other beach-specific factors. All beach stations were located within the boundaries of the bathing area and were spaced at approximately equal distances from

each other, parallel to the shoreline. In general, they were located at a point where the water was 1-1.5 meters deep. However, where the water depth in the bathing area was less than this, the stations were located at the deepest available point while still remaining within the boundaries of the bathing area. All pertinent data such as water depth, bottom composition, shoreline characteristics, etc., were recorded on Station Description Forms. In addition, all beach stations were further identified using permanent local landmarks to which the sampler would refer when collecting samples. This assured that the water samples were collected at the same spot during each sampling run. Slight adjustments to the location of several of the beach stations were necessary during the bathing season due to heavy growths of water plants.

1.2.2 Off-Beach Stations

Sampling stations that were located outside the boundaries of the bathing area were called 'off-beach stations'. These stations were used to delineate the sources or causes of high bacterial levels in the water of the bathing area. Off-beach stations were composed of three types: outfall, input or control. Samples from outfall stations were collected at or near the shoreline from the discharge before it reached the main water body. Typically, these stations were located in the outfall from a ditch or storm sewer. At a number of these stations, the discharge was intermittent, often being associated with major rainfalls. Flow rates (observed, not measured) were noted during each sampling run.

Input stations were located either in a river upstream of the bathing area or in the lake at a point where a current might exist which could bring bacterial contaminants into the bathing area.

Control stations were located in the main water

body and were used to monitor the bacterial levels beyond the influence of a given variable. In some cases, a single off-beach station provided data for several nearby beaches. Thus, off-beach stations were not always specific to one bathing area.

1.3 BACTERIOLOGICAL SAMPLING METHODS

1.3.1 Sample Collection and Transport

Bacteriological samples were collected in sterile, 250 ml, glass bottles containing sodium thiosulphate. All beach and many off-beach samples were collected using a 1.8 m sampling rod at a sampling depth of 15-30 cm below the surface of the water. Outfall samples were usually collected holding the sampling bottle in the water flow with the hand.

Beach samples were collected by an individual (usually wearing chest-high waders) walking out to the selected sampling station. When the station was reached, the cap was removed and using the sampling rod, the sample bottle extended away from the body as far as possible. The sample bottle was plunged (mouth downward) to the proper sampling depth into water that was undisturbed by the sampler. The bottle was pushed forward, while tilting it slightly upward to allow filling. Once filled, the bottle was taken from the water, a small amount of water poured off, and recapped. Immediately following collection, the samples were placed in a cooler containing ice packs and transported to the laboratory as soon as possible.

1.3.2 Sampling Frequency

Established bathing areas were sampled a minimum of once per week for a period of thirteen weeks, beginning in the first full week of June and ending in the last week of August, 1984. Additional samples were collected

at specific beaches to monitor the impact of bather loading and rainfall. Unfortunately, it was not possible to sample at all beaches following a heavy rainfall. Further samples were collected whenever the bacterial levels exceeded a geometric mean of 100 fecal coliforms per 100 ml. Infrequently used bathing areas were sampled less often than established, well-used bathing areas. Off-beach samples were collected as required either to monitor specific events or determine long-term trends. Sample collection from certain off-beach stations was discontinued as soon as the impact of that source could be discounted as a factor that influenced bacterial levels at the beach.

1.4 METEOROLOGICAL METHODS

1.4.1 Rainfall Monitoring

The quantity of rain falling during each 24 hour period at each beach was required to monitor the effect of rainfall. Initially, Environment Canada precipitation record at the Thunder Bay Airport was used for this purpose. However, this proved to be inadequate due to the unequal distribution of rain falling at each beach. Therefore, in early July, three non-recording rain gauges were set up close to each of the three major bathing areas. The location selected was not always ideal but was based on the dual requirement for convenient daily monitoring and avoidance of vandalism. Precipitation was recorded daily at each of these locations in addition to that recorded by Environment Canada.

Each rain gauge consisted of a copper funnel, 7.6 cm in diameter, mounted on a copper base. The base enclosed a plastic container in which the rain falling into the funnel collected. Each rain gauge was set up in an open, level area so that it was the highest point within 10 meters and free from the

influence of overhanging buildings or trees. The mouth of the funnel was approximately 30 cm above ground level. Prior to each sampling run the volume of water collected since the last reading was measured and recorded.

During the course of the summer, an arbitrary rainfall scale was established. The requirement to collect additional samples was based on this scale. The amount of rain falling in any 24 hour period was divided into light, medium and heavy. These levels corresponded to "less than 5 mm", "5-10 mm", and "greater than 10 mm", respectively. At selected beaches, additional bacteriological samples were collected daily for up to three days following a rain that was 5 mm or greater.

1.4.2 Other Meteorological Monitoring

At the time of sampling a given beach, the direction and intensity of the wind, percentage cloud cover and air temperature were recorded. Wind direction was recorded as 'onshore', 'offshore' or 'parallel' to the beach shoreline. Wind intensity was estimated and recorded as 'calm', 'light', 'medium', or 'high'. The amount of cloud covering the sky was estimated and the percentage of the sky covered was recorded. Air temperature was measured using a laboratory grade thermometer.

1.5 OTHER FIELD DATA

1.5.1 Water Temperature

The temperature of the water at each station was measured during each sampling run using a laboratory grade thermometer. The thermometer was allowed to equilibrate for 2-3 minutes in the water at the sampling depth prior to reading.

1.5.2 Sample Collection Time

The time that each sample was collected was recorded.

1.5.3 Wave Action

Wave action was estimated by the sampler at the time of sampling using an arbitrary scale (calm/light/medium/high). This scale was relative to each beach since the diverse nature of the beaches made subjective judgments of wave size necessary

1.5.4 Bather Load

At the time of sampling, the number of bathers using each beach was estimated according to the following criteria:

- Number of bathers in the water within 5 m of the sampling location.
- Number of bathers in the water in the bathing area.
- Total number of people in the water and on the beach adjoining the bathing area.

1.5.5 Field Notes

A diary of notable events that occurred during each sampling run was maintained.

2. LABORATORY METHODS

Upon receipt at the MOE Thunder Bay Laboratory, all water samples were immediately removed from the transport cooler and refrigerated. In the laboratory, samples were maintained at 4°C. Bacteriological examination was started within 1 to 4 hours of sample collection. Initially, all samples were analyzed for total coliform (TC) bacteria, fecal coliform (FC) bacteria, Escherichia coli (EC), fecal streptococcus (FS) bacteria, and Pseudomonas aeruginosa (PSA). Later in the season, once the relative levels of certain bacterial indicator groups were established, the number of bacterial parameters routinely analyzed was reduced for specific beaches. In addition to the bacteriological examination, a turbidimetric analysis of selected samples was started in early June.

2.1 BACTERIOLOGICAL METHODS

All bacteriological water samples were analyzed using MOE procedures (1). E.coli was analyzed using a developmental procedure. A brief outline of the analytical procedures is given below.

PARAMETER	METHOD	MEDIUM	INCUBATION	CONDITIONS
TC	MF	m-endo agar LES	35.0°	22±2 hrs
FC	MF	m-TEC agar	*44.5°	23±2 hrs
FS	MF	m-enterococcus agar	35.0°	48±3 hrs
EC	MF	m-TEC-IG agar	*44.5°	23±2 hrs
PSA	MF	m-PA-E agar	41.5°	48±3 hrs

* Temperature increase to 44.5°C slowed using ice method.

2.2 TURBIDIMETRIC METHODS

Following bacteriological analysis, the turbidity of selected samples was determined by the nephelometric method (1) using a Hack model 2100A turbidimeter. Samples not analyzed immediately for turbidity were stored at 4°C for later testing.

2.3 NOTIFICATION METHODS

Final bacteriological results for all beaches were reported to the Medical Officer of Health at the Thunder Bay District Health Unit (TBDHU). However, since the final copy of the analytical results was often delayed beyond that necessary for placarding purposes, laboratory staff notified the TBDHU staff by telephone as soon as the results at a given beach were found to exceed the Provincial guideline. This permitted a faster response to potentially hazardous bathing conditions.

2.4 DATA ANALYSIS

The bacteriological results were statistically analyzed. All 'greater than' data were treated as real numbers. This would underestimate the actual value, but was preferable to deleting the data totally. TC, FC, EC, and FS results of 10 or less than 10, were treated as a simple numerical value of 10. Several bather load records were incomplete; these are indicated by a blank space or a value of 999 in the tables.

3. PROVINCIAL WATER QUALITY GUIDELINE

During the 1984 bathing season, the decision to placard a bathing area was based, in part, upon the levels of fecal coliform bacteria present in the water. The Thunder Bay Medical Officer of Health had sole responsibility for this decision for bathing areas in the District of Thunder Bay.

The Ministry of Health bacteriological water quality guideline for bathing beaches used in 1984 is stated below:

"The quality of bathing beach waters is considered impaired when the ... fecal coliform geometric mean exceeds 100 per 100 ml" (4).

RESULTS AND DISCUSSION

1. ENVIRONMENT CANADA RAINFALL DATA

The rainfall data generated by Environment Canada at the Thunder Bay Airport were used during June and early July to monitor rainfall events at all local beaches. However, it soon became apparent that many of the storms passing through were quite localized and dropped substantially different quantities of rain at the different parks. For this reason, rain gauge equipment was established at three of the parks.

Environment Canada measured and recorded precipitation falling within each 24 hour period. Readings were taken early each morning and the values applied to the previous day. Between June 1 and July 12, 1984, readings were taken at 7:00 a.m. From July 13 until the end of August, readings were taken at 8:00 a.m.

The rainfall data for the month of June, 1984, are illustrated in Figure 1 and for July and August, 1984, in Figure 2.

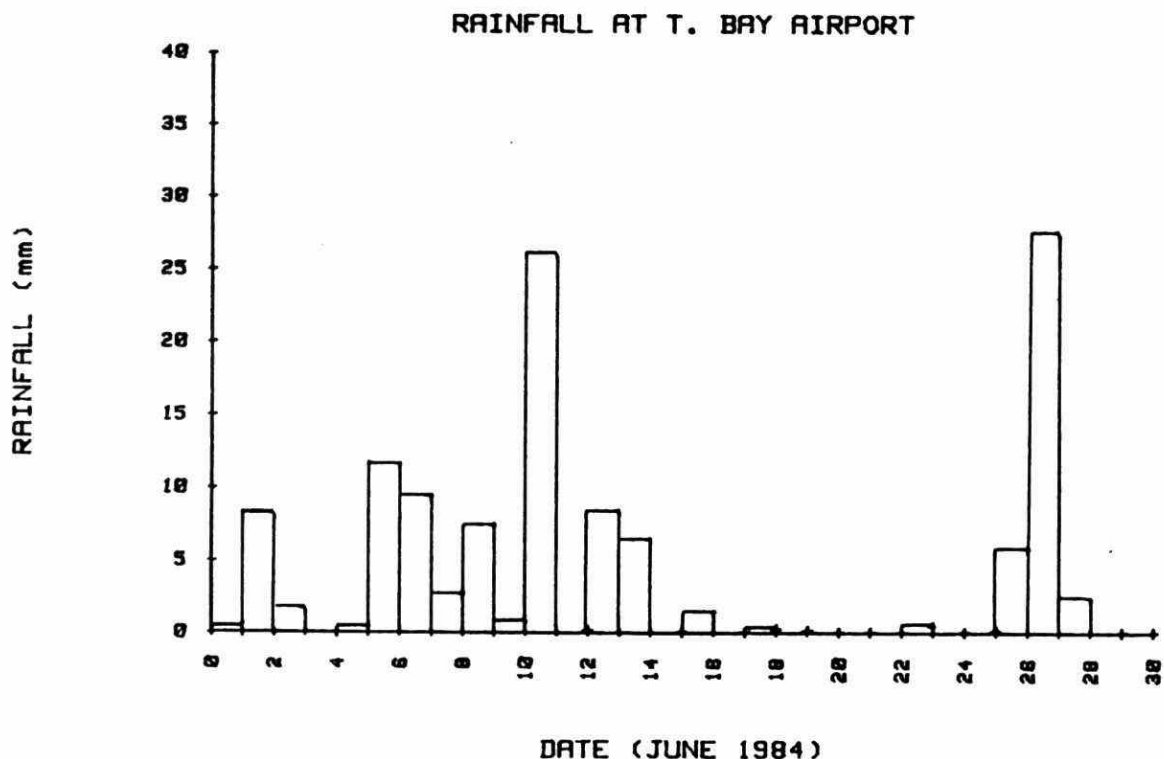


Figure 1. Rainfall recorded within each 24 hour period during June, 1984 by Environment Canada at the Thunder Bay Airport.

RAINFALL AT T.BAY AIRPORT

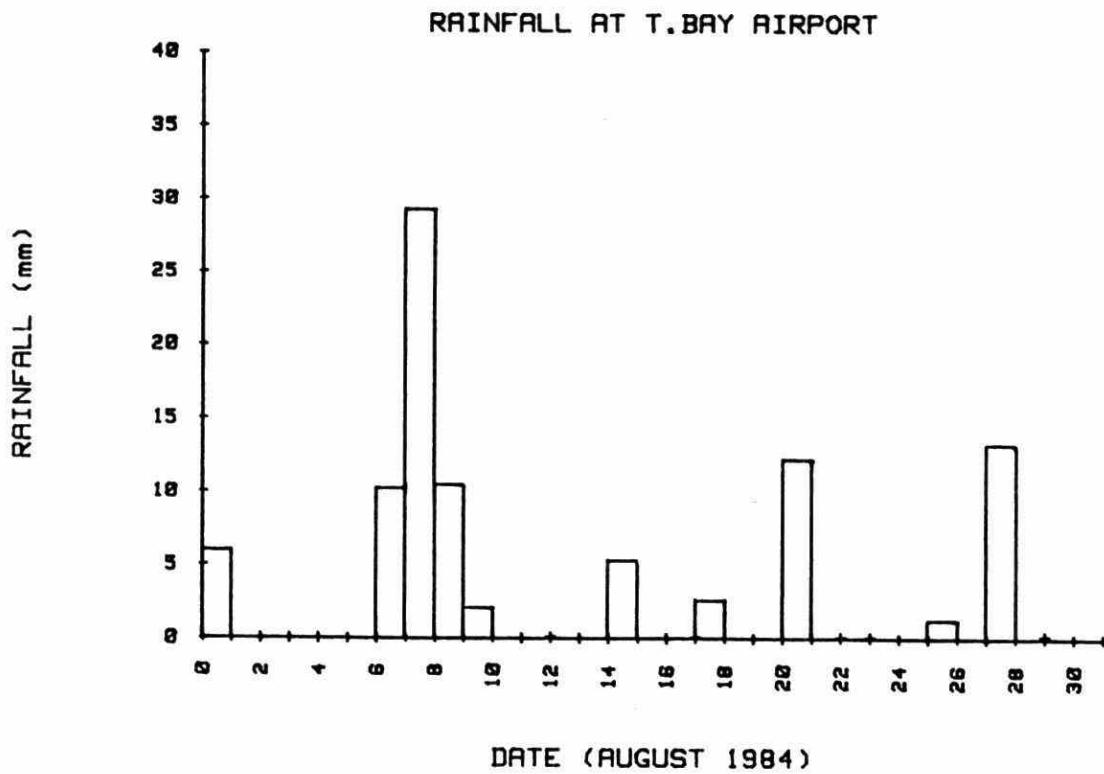
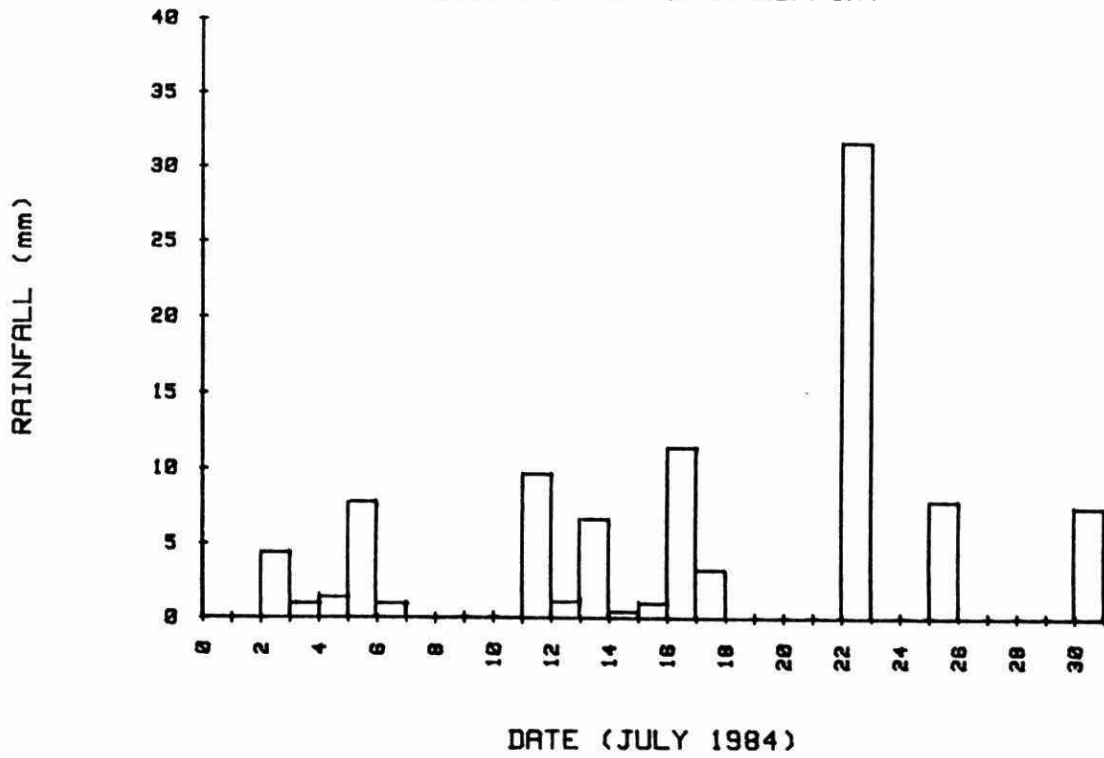


Figure 2. Rainfall recorded within each 24 hour period during July and August, 1984 by Environment Canada at the Thunder Bay Airport

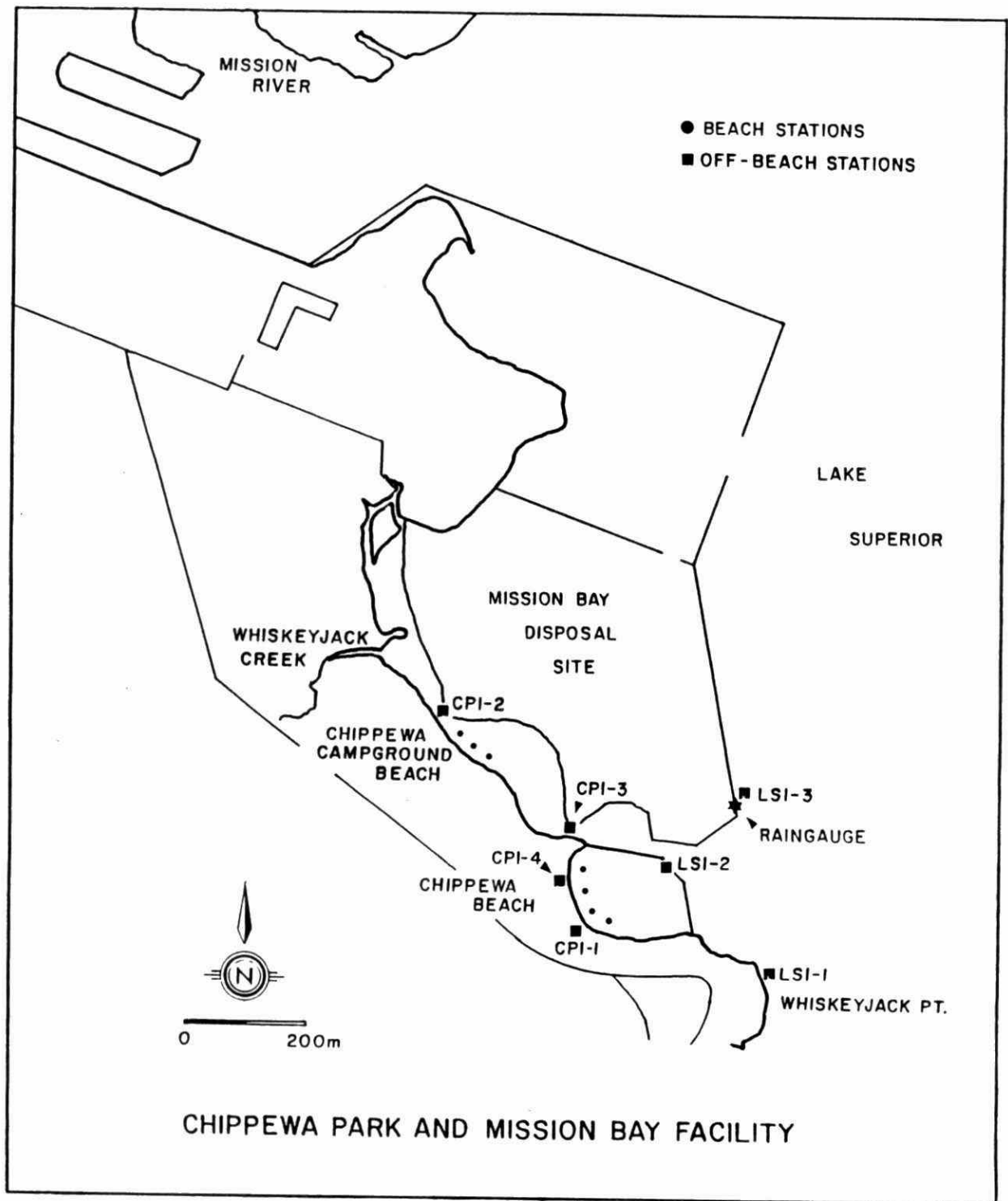


Figure 3. Chippewa Park and Mission Bay Facility.

2. CHIPPEWA PARK

Chippewa Park is located on the shore of Lake Superior near the southern edge of Mission Bay (Figure 3). Mission Bay, however, has essentially disappeared due to the construction of the Mission Bay Dredge Disposal Facility which lies directly to the north of the park. The park lies within the boundaries of and is administered by the City of Thunder Bay. It has two bathing areas: Chippewa Beach, the principal bathing area in the park, and Chippewa Campground Beach beside the trailer park camping area.

2.1 RAINFALL DATA

A rain gauge was set up on the berm of the dredge disposal area near station LSI-3 (Figure 3). Rainfall was recorded at this location from July 12 to August 31, 1984. These results are illustrated in Figure 4. Readings were taken prior to each sample collection run at this park. Since samples were not collected at the same time each day, the time interval between readings was not always 24 hours. Therefore, the rainfall quantities shown in Figure 4 are approximate values for each 24 hour period. Nevertheless, this method assured that heavy rain which fell just prior to a sampling run would be recorded with that run.

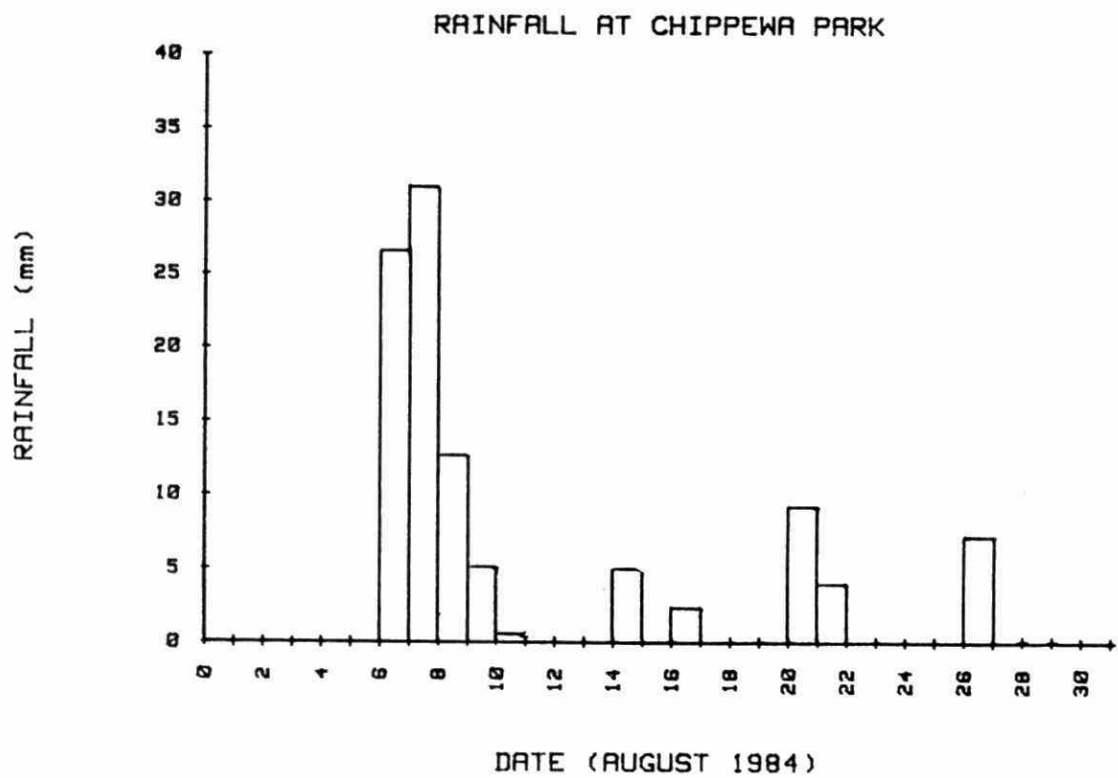
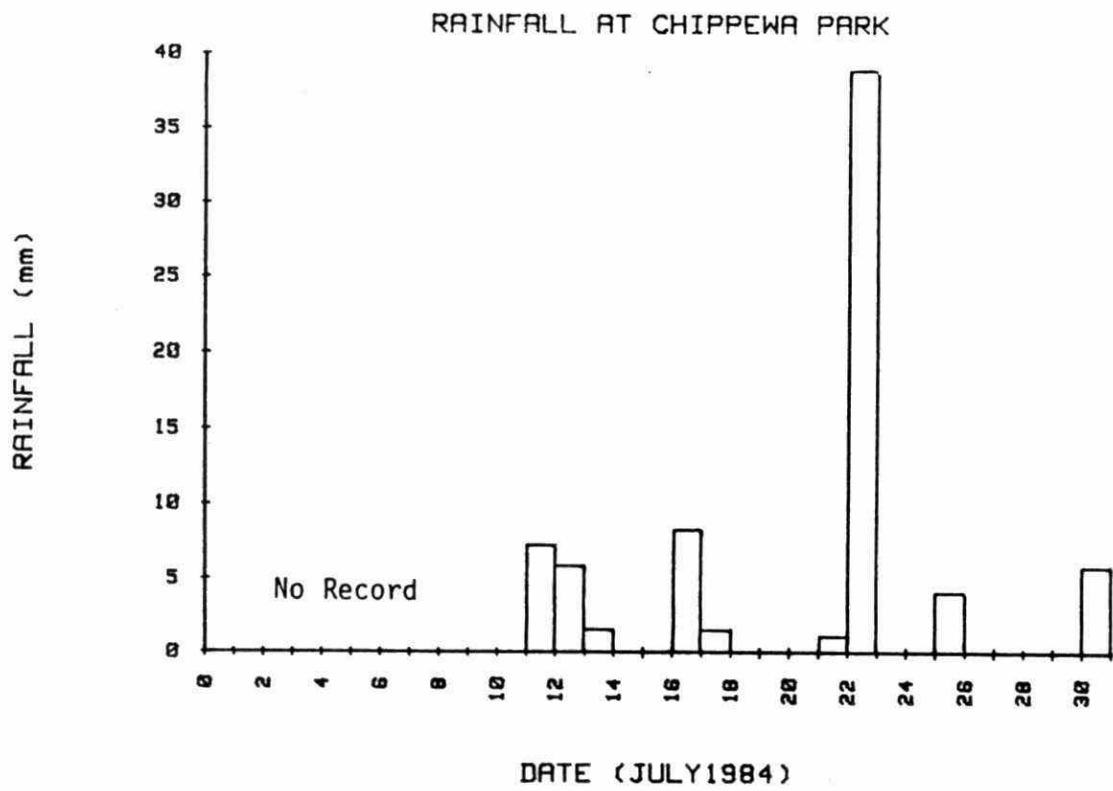


Figure 4. Rainfall recorded from July 12 to August 31, 1984 at Chippewa Park.

2.2 CHIPPEWA BEACH

2.2.1 Background

During the summer of 1983, Chippewa Beach was placarded on two separate occasions as a result of high fecal coliform bacterial levels in the bathing area water. In 1983, both the collection and the analysis of beach samples were conducted by the TBDHU staff. However, based on the data available from the 1983 surveys, it was not possible to pinpoint the source or sources of the fecal bacteria that were contaminating the bathing area (5).

2.2.2 Description

The bathing area at Chippewa Beach lies along the western portion of a water body that is most easily described as a lagoon (Figure 5). The water contained in this lagoon is almost totally enclosed by a long, curving sandy beach to the west and south, a breakwater to the north, and a boardwalk to the east. Both of these latter features not only protect the bathing area from large waves but also tend to restrict the exchange of water to and from Lake Superior. The water in the bathing area is relatively clear and uncoloured allowing the bottom to be easily seen. The water depth in the bathing area does not exceed one metre, and in fact, the water depth of the entire lagoon does not exceed two metres. The bottom composition of the bathing area is sand and mud that is easily resuspended. During the course of the summer, large patches of water plants grew in the lagoon, extending into parts of the bathing area. The bathing area is backed by a gently sloping, sandy beach which, at places, extends some distance from the water. A paved parking lot lies next to one portion of the sandy beach. Grass covered recreational areas and clumps of trees lie further inland.

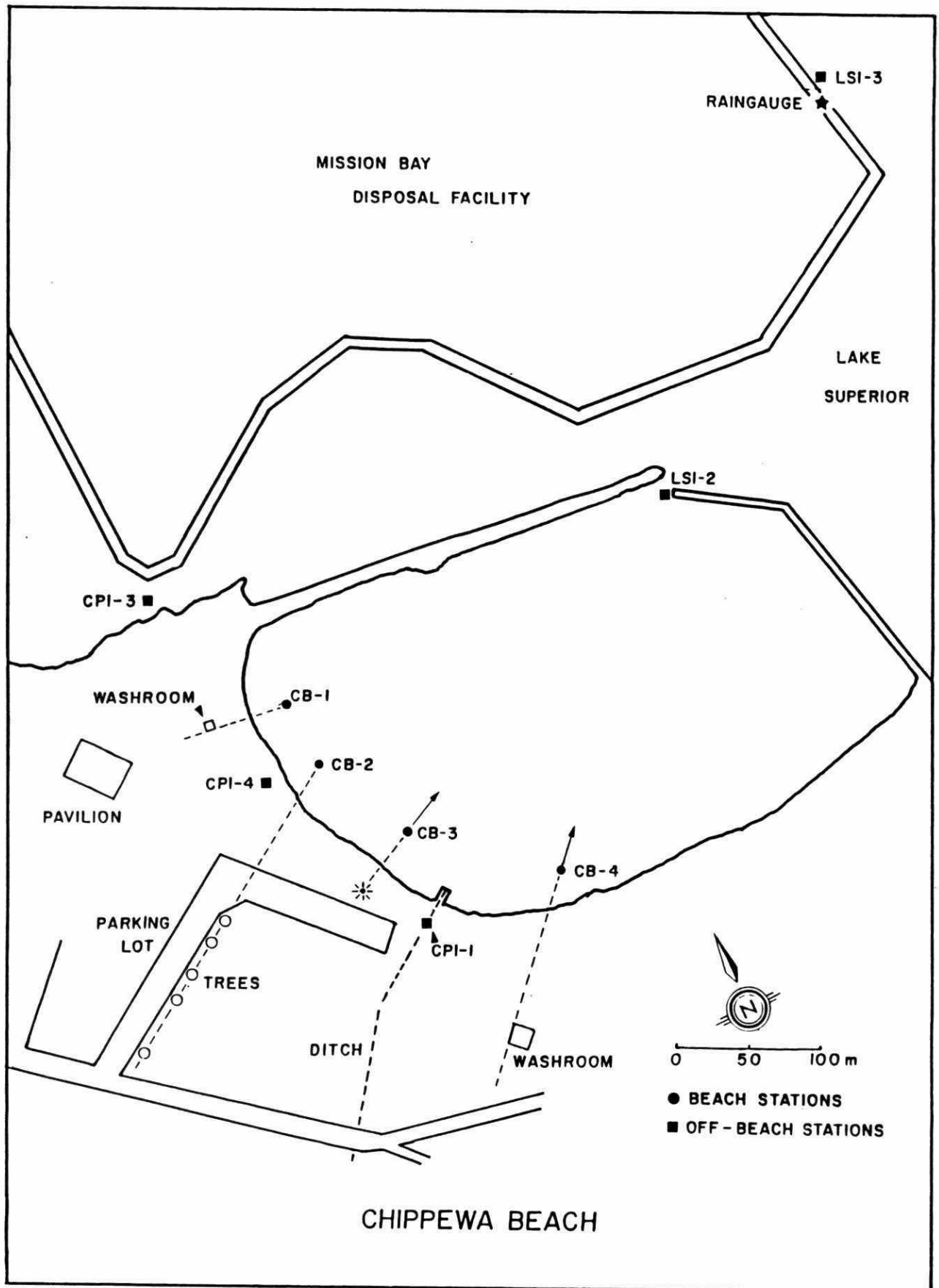


Figure 5. Chippewa Beach.

2.2.3 Sanitary Survey

The sanitary survey conducted on May 29, 1984, at Chippewa Beach revealed only one outfall that might have an impact on the water quality of the bathing area. This was a ditch which emptied into the southern portion of the bathing area. At the time of the sanitary survey, this ditch contained continuously flowing water. The source of this water appeared to be run-off and/or seepage from a wooded area on the far side of the main road. Several other culverts or pipes ending on the southwestern side of the lagoon were also noted. However, no water was flowing from any of these pipes at that time.

2.2.4 Sampling Stations

Four beach stations were established at evenly spaced points parallel to the shoreline within the bathing area. These stations were called CB-1, CB-2, CB-3, and CB-4. Due to the shallow depth of water in this lagoon, the beach stations were located at a point where the water depth was less than one metre in order that they remain within the bathing area. During the course of the summer, stations CB-3 and CB-4 were moved slightly closer to shore because of the heavy growth of water plants.

Five off-beach stations were established: CPI-1, CPI-4, LSI-1, LSI-2 and LSI-3. Station CPI-1 was located at the entrance to a culvert in the ditch noted above. Water flowed continuously in this ditch until mid-August at which time the flow almost stopped except following a rainfall. Water from the ditch entered the bathing area between stations CB-3 and CB-4. Station CPI-4 was located at the end of a culvert which ended in the sand of the beach. This culvert was overlooked during the sanitary survey since it was completely buried at that time. The source of the water flowing from the culvert was never confirmed although the culvert pointed

in the direction of the parking lot. Water flowed from this culvert only for one or two days following a heavy rainfall. Water from the culvert entered the bathing area between station CB-1 and CB-2.

Three off-beach stations were established in Lake Superior near the park. Station LSI-3 was located beside the lakeside berm of the dredge disposal facility north of Chippewa Beach. Station LSI-1 was located south of the lakeside opening to Chippewa Beach at Whiskeyjack Point. Station LSI-2 was located at the lakeside opening to Chippewa Beach at the end of the boardwalk.

2.2.5 Methods

Initially, all stations were sampled on a weekday morning at least once per week. In early July, the sampling frequency was increased to almost daily sample collections. On the weekend, beach station samples were collected in the afternoon when bather loading was expected to be heavier. Initially, all samples were analyzed for TC, FC, EC, FS and PSA. However, after July 17, when it appeared that PSA was infrequently detected, this parameter was deleted. In addition, to accommodate the increased workload of daily sampling, TC and FS were also deleted from the routine analysis.

2.2.6 Results and Discussion

Chippewa Beach stations CB-1 to CB-4 were sampled once per day on sixty separate occasions over the period May 29 to August 31, 1984. No significant differences in the bacteriological data were found between these stations. The fecal coliform seasonal geometric mean for the beach stations was 40 per 100 ml.

During this period, the fecal coliform daily geometric mean of the four beach stations was found to exceed 100 per 100 ml on eleven days (underlined

TABLE 1. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT CHIPPEWA BEACH, CHIPPEWA PARK (ALL DATA)						May 29/84 TO
						Aug 31/84
SAMPLING DATE	FECAL COLIFORM COUNTS PER 100 ML				DAILY	
YY MM DD	BEACH STATION NUMBERS				GEOM.	
	CB1	CB2	CB3	CB4	MEAN	
184 5 29	101	101	101	101	10.01	
184 6 5	10501	6101	15001	5801	864.01	
184 6 6	2601	4501	4901	3301	370.91	
184 6 12	601	101	1001	801	46.81	
184 6 19	101	101	201	101	11.91	
184 6 26	4301	2001	3301	2301	284.21	
184 6 28	3101	3401	4101	2301	315.71	
184 6 29	1301	1001	1001	701	97.71	
184 7 3	701	1401	201	201	44.51	
184 7 6	2401	2401	2401	2401	240.01	
184 7 8	201	501	101	101	17.81	
184 7 9	701	901	101	101	28.21	
184 7 10	601	701	101	101	25.51	
184 7 11	101	101	401	101	14.11	
184 7 12	201	101	401	301	22.11	
184 7 13	1701	2401	401	101	63.61	
184 7 14	2401	2401	401	301	91.21	
184 7 15	201	401	201	301	26.31	
184 7 16	101	101	101	101	10.01	
184 7 17	101	301	201	101	15.71	
184 7 18	101	401	201	101	16.81	
184 7 19	401	401	101	101	20.01	
184 7 20	101	201	101	101	11.91	
184 7 21	101	101	201	101	11.91	
184 7 22	301	201	201	101	18.61	
184 7 23	2001	1801	2601	2401	217.71	
184 7 24	1	701	701	501	62.61	
184 7 25	101	101	201	301	15.71	
184 7 26	601	101	301	101	20.61	
184 7 27	101	101	301	301	17.31	
184 7 29	101	301	101	201	15.71	
184 7 30	101	201	101	301	15.71	
184 7 31	401	101	101	801	23.81	
184 8 1	1101	501	101	101	27.21	
184 8 2	201	101	401	201	20.01	
184 8 3	101	101	101	101	10.01	
184 8 5	201	1401	101	301	30.31	
184 8 6	801	1	701	201	48.21	
184 8 7	2301	3201	3401	4601	327.61	
184 8 8	5601	5801	6201	1401	409.81	
184 8 9	5401	7201	6801	2401	501.91	
184 8 10	1201	1301	1301	701	109.21	
184 8 11	101	801	901	1801	60.01	
184 8 12	301	101	301	301	22.81	
184 8 13	301	201	101	101	15.71	
184 8 14	401	201	101	301	22.11	

TABLE 1. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT CHIPPEWA BEACH, CHIPPEWA PARK (ALL DATA)							May 29/84 TO Aug 31/84
SAMPLING DATE YY MM DD	FECAL COLIFORM COUNTS PER 100 ML BEACH STATION NUMBERS					DAILY GEOM. MEAN	
	CB1	CB2	CB3	CB4			
84 8 15	20	20	60	90		38.3	
84 8 16	70	60	10	30		33.5	
84 8 17	60	40	30	10		29.1	
84 8 19	10	40	30	60		29.1	
84 8 20	30	20	70	10		25.5	
84 8 21	60	140	40	90		74.2	
84 8 22	40	40	120	40		52.6	
84 8 23		70	70	30		52.8	
84 8 24	30	70	10	10		21.4	
84 8 27	30	100	870	390		178.6	
84 8 28	10	30	40	100		33.1	
84 8 29	10	20	40	30		22.1	
84 8 30	20	20	40	20		23.8	
84 8 31	10	10	20	10		11.9	
GEOM. MEAN	39.6	44.9	40.9	33.5			

values in Table 1). As a result of finding fecal coliform geometric means in the bathing area that exceeded the Provincial guideline, the Medical Officer of Health ordered the erection of placards at Chippewa Beach. Placards at a bathing area indicates "that the water quality in a particular area is hazardous to bathers and that they should bathe only at their own risk"(4). The placards were in place from June 28 to July 12 and from August 10 to August 13, 1984.

The eleven occasions on which high FC levels were observed can be grouped into six separate 'pollution' events. These pollution events are listed in Table 2 along with other factors that may have contributed to each event. Each event was preceded by a heavy rainfall in the 24 to 43 hours prior to sampling. (In Figure 1, the June 5th reading was recorded only at the Thunder Bay Airport. This value is not applicable

to Chippewa Beach on that day as field notes indicated that a heavy rain immediately preceeded that sampling run). Discrepancies such as this indicated the need for on-site rain gauging equipment.

Other factors such as wind and wave action may have had an additional contribution to the elevated FC level of the beach samples on June 5. Higher than average turbidity levels were observed for the majority of the six pollution events. This was not unexpected as heavy rainfall is often associated with wind and wave action that stir up the sediment of shallow bathing areas. In addition, turbid stormwater flowing into the bathing area may increase the turbidity of the bathing area water. Bather loading was uniformly low during each event. Similarly, on those sampling runs, none of the other factors were observed to be unusual.

The cause of the fecal contamination at Chippewa Beach appeared to be primarily the result of stormwater run-off. Stormwater run-off is known to contain substantial levels of fecal bacteria (3). Generally, these fecal bacteria are considered to come from bird and animal droppings or other non-specific sources. Rainfall washes these contaminants into the bathing area from the beach or into ditches which subsequently drain into the bathing area.

The principal sources of stormwater at Chippewa Beach were the two outfalls CPI-1 and CPI-4. Following a heavy rain both of these outfalls usually contained elevated fecal coliform levels. A specific fecal source of the bacteria could not be found near the ditch, upstream of CPI-1. Similarly, the exact source of the water flowing at station CPI-4 was not established. Water usually flowed at this station following heavy rainfall. Inexplicably, on August 7, following an extremely heavy rain at Chippewa Park, no flow was observed at this station.

Throughout the summer of 1984, the bathing area at Chippewa Beach did not appear to be contaminated

TABLE 2. Chippewa Beach 'pollution' events and coincident factors

EVENT NO	SAMPLE DATE	RAIN (mm)	WIND		WAVE ACTION	BATH LOAD	TURB	WATER TEMP	FC/100 ml					
			DIR	INTENS					BEACH	CPI-1	CPI-4	LSI-2	LSI-3	LSI-1
1	June 5	0.4	on	med.	med.	0	9.4	14	864	228		10	10	10
	June 6	11.6	on	light	light	0	5.7	16	371	40	1500	50	10	20
2	June 26	5.8	off	light	light	0	2.6	17	284	110		60	20	60
	June 27	27.6												
	June 28	2.4	off	med.	calm	0	2.4	15	315		370			
3	July 6	7.8							240			240		
4	July 23	38.9	off	light	light	0	4.1	19	218	550	700	110	80	200
5	Aug. 7	26.5	on	light	light	0	5.1	18	328	5200		300	100	200
	Aug. 8	30.9	on	light	light	6	5.6	20	410	1100	2600	40	10	20
	Aug. 9	12.6	on	light	calm	0	6.2	19	502	490	570	60	10	10
	Aug. 10	5.0	on	med.	light	0	5.3	19	109	190	230	40	10	20
6	Aug. 27	7.1	off	light	light	0	3.8	17	178	1200		10	40	30

by fecal bacteria reaching it via Lake Superior and the Mission River environs. Only relatively low levels of fecal coliform bacteria were found at station LSI-3 throughout the summer of 1984. This station was located in the most likely path that a plume from the Mission River area would follow. An earlier report (5) suggested that this could be a source of fecal coliform bacteria because of the elevated levels found in Lake Superior near the lakeside opening to the beach during a 1983 survey. This may occur, however, it was not observed in 1984.

The majority of the fecal bacteria recovered either at the beach stations or the off-beach stations were E.coli. This organism is indicative of a fecal source. Levels up to 600 E.coli per 100 ml were observed at several of the beach stations following heavy rainfall. P.aeruginosa (PSA) was detected in only a small proportion of the beach and off-beach samples. Only one value exceeded 10 PSA per 100 ml throughout the summer. Fecal streptococcus bacteria were usually present in most beach samples. Levels ranged from less than 10 to 1370 per 100 ml.

The levels of fecal coliform bacteria and E.coli declined below 100 per 100 ml within 48 hours of a heavy rainfall. In several instances, the numbers of each group fell below 100 within 24 hours. Thus, rainfall did not appear to cause a persistent effect on the water quality of the bathing area at Chippewa Beach. The reduction in the levels of fecal coliforms and E.coli was probably a combination of die-off and settling of the bacteria into the bottom sediments. Once in the sediments, these bacteria could probably survive for some time. Thus, a resuspension of the sediments would again lead to elevated fecal coliform and E.coli levels in the water column.

An example of this was clearly demonstrated on August 22, 1984, at beach station CB-3. On that day, high waves were recorded at this station. The turbidity

of the sample collected was approximately four times higher than the average turbidity for calm, dry weather conditions. The levels of both fecal coliforms and E.coli were substantially above those recorded during the previous four or five days at this station. Fortunately, however, Chippewa Beach is well protected from the high waves of Lake Superior. Nevertheless, once fecal bacteria have gained access to the bathing area, they may accumulate in the sediments and continue to pose a problem when they are resuspended into the water, either by wave action or the bathers themselves.

The only source of fecal bacteria identified at Chippewa Beach was stormwater run-off. Presently, there appears to be little that can be done to correct this problem due to the topography of the land behind the beach. Therefore, high levels of fecal coliform bacteria in the bathing area may be expected in the future. In fact, this situation may have been occurring at Chippewa Beach for a number of years.

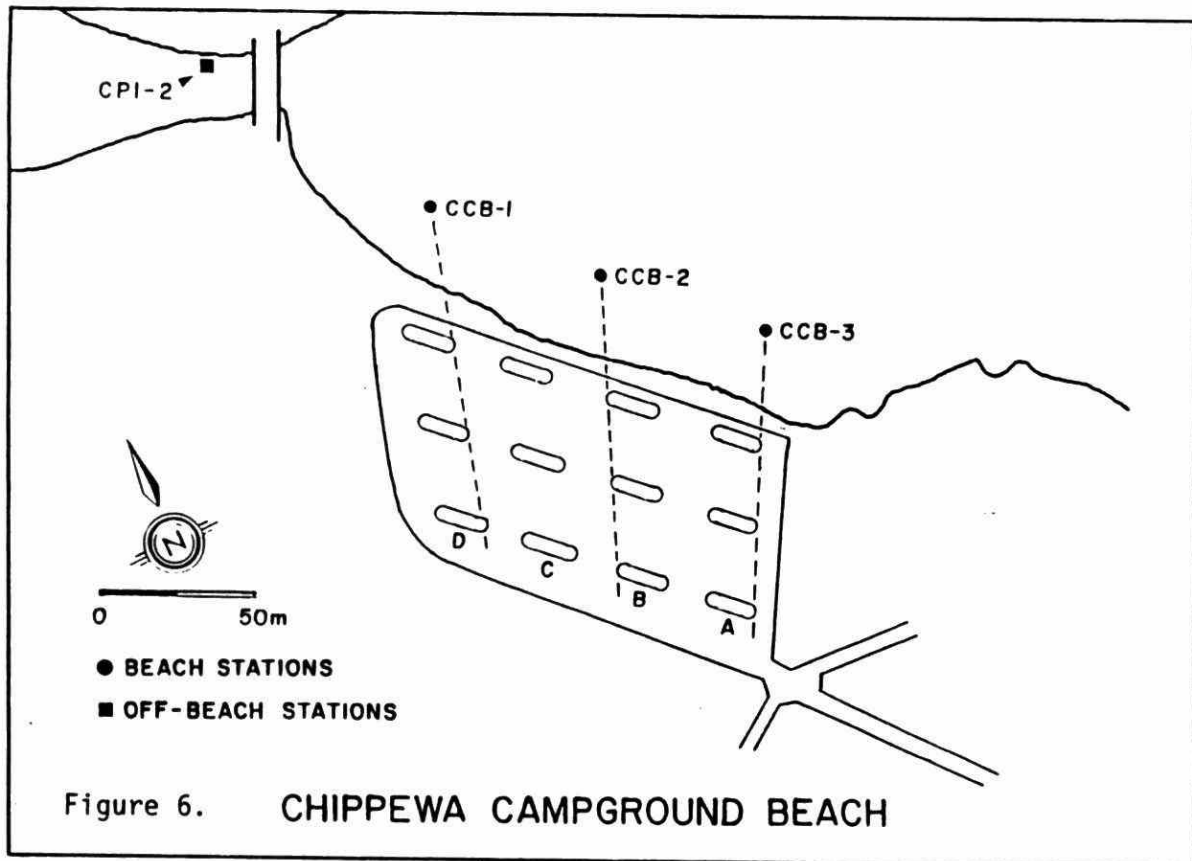
2.3 CHIPPEWA CAMPGROUND BEACH

2.3.1 Background

During the summer of 1983, only two samples were collected from the bathing area at Chippewa Campground Beach. These samples were collected on July 28. Both samples contained less than 100 FC per 100 ml. However, during the second week of August, two additional samples were collected downstream of the beach from the water behind the pavilion. Both of these samples contained more than 240 FC per 100 ml. Since the water behind the pavilion and the bathing area form one continuous water body, it is probable that the bathing area also contained elevated levels of fecal coliform bacteria at that time. This was not confirmed. The source of the fecal coliform bacteria could not be determined due to the limited data available. Chippewa Campground Beach was not placarded at any time during the summer of 1983.

2.3.2 Description

Chippewa Campground Beach is located near the northwestern end of Chippewa Park (Figure 3). This beach lies inland from the shore of Lake Superior, being almost totally surrounded by land. Only a narrow, shallow channel connects the bathing area with Lake Superior. The water in the bathing area has a distinct brown colouration, typical of many northern rivers and lakes. The bottom of the bathing area is composed of sand and mud that can be easily resuspended. The bathing area is quite shallow, being less than one metre deep some distance from shore. The sand on the beach had been trucked in and spread shortly before the start of the 1984 sampling program. The shoreline is relatively straight. The beach slopes gently up toward the trailer camping area (Figure 6). The trailer camping area is covered with gravel.



2.3.3 Sanitary Survey

The sanitary survey conducted on May 29, 1984, revealed only one source that might have an impact on the water quality of the bathing area. This source was the combined flow of water from Whiskeyjack Creek and the wetlands area to the north of the bathing area. This water moves slowly through the bathing area toward Lake Superior.

2.3.4 Sampling Stations

Three beach stations were established at evenly spaced points parallel to the shoreline within the bathing area (Figure 6). These stations were called CCB-1, CCB-2, and CCB-3. Due to the shallow depth of water at this beach, the beach stations were located at a point where the water depth was less than one metre

in order that the stations remained within the bathing area. During the course of the summer, stations CCB-2 and CCB-3 were moved even closer to shore because of the heavy growth of water plants.

Two off-beach stations were established: CPI-2 and CPI-3 (Figure 3). CPI-2 was located just west of the bridge, upstream of the bathing area. This station was used to monitor the quality of water from the Whiskeyjack Creek area. CPI-3 was located at a point behind the pavilion where the channel narrows, downstream of the bathing area. This station was used to detect any fecal contaminants coming from the direction of Lake Superior.

2.3.5 Methods

All stations were sampled on a Wednesday morning each week throughout the summer. Additional samples were collected each day for three days following a heavy rainfall. The majority of these additional samples were collected in the morning. However, some collections were made in the afternoon. Initially, all samples were analyzed for TC, FC, EC, FS and PSA. In mid-July and continuing until the end of August, only FC and EC were regularly analyzed.

2.3.6 Results and Discussion

Chippewa Campground Beach stations CCB-1 to CCB-3 were sampled once per day on thirty separate days over the period May 29 to August 31, 1984. No significant differences in the bacteriological data were found between these stations. The seasonal fecal coliform geometric mean for the three beach stations was 48 per 100 ml.

During this period, the fecal coliform daily geometric mean of the three beach stations was found to exceed 100 per 100 ml on seven occasions (underlined

TABLE 3. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT CHIPPEWA CAMPGROUND BEACH, CHIPPEWA PARK (ALL DATA)							May 29/84 TO Aug 31/84
SAMPLING DATE	FECAL COLIFORM COUNTS PER 100 ML BEACH STATION NUMBERS					DAILY GEOM. MEAN	
YY MM DD	CCB1	CCB2	CCB3				
184 5 29	44	32	8			22.4	
184 6 5	280	770	1010			601.6	
184 6 6	370	370	280			337.2	
184 6 12	10	50	20			21.5	
184 6 19	10	10	20			12.6	
184 6 26	40	70	90			63.2	
184 6 28	10	40	50			27.1	
184 6 29	10	10	20			12.6	
184 7 3	10	40	20			20.0	
184 7 10	20	10	10			12.6	
184 7 12	30	20	20			22.9	
184 7 13	60	20	50			39.1	
184 7 14	30	10	20			18.2	
184 7 17	20	10	10			12.6	
184 7 23	520	350	290			375.1	
184 7 24	50	50	110			65.0	
184 7 25	50	10	30			24.7	
184 7 31	90	60	20			47.6	
184 8 7	60	80	150			89.6	
184 8 8	240	100	240			179.3	
184 8 9	190	130	170			161.3	
184 8 10	110	50	70			72.7	
184 8 11	130	80	30			67.8	
184 8 12	60	30	20			33.0	
184 8 21	210	390	400			320.0	
184 8 22	10	20	190			33.6	
184 8 23	20	50	20			27.1	
184 8 27	150	40	900			175.4	
184 8 28	30	30	20			26.2	
184 8 31	10	10	30			14.4	
GEOM. MEAN	47.5	43.3	54.6				

values in Table 3). Chippewa Campground Beach was not placarded at any time throughout the summer of 1984.

The seven occasions on which the fecal coliform daily geometric mean exceeded 100 per 100 ml was grouped into five separate 'pollution' events. These events are listed in Table 4 along with the other variables recorded on those sampling dates. Each event was preceded by a heavy rainfall. Wind, wave action and bather load were not contributory factors to these events. However, the turbidity of the water in the bathing area was slightly elevated over dry weather conditions during each of these pollution events. Nevertheless, these increased turbidity levels were much less significant at Chippewa Campground Beach than at Chippewa Beach.

The cause of the fecal contamination at Chippewa Campground Beach appeared to be primarily the result of stormwater run-off. One source of this run-off was the water flowing from the Whiskeyjack Creek environs. At the bridge (CPI-2), fecal coliform levels of 100 per 100 ml or greater were observed within 24 hours of each rainfall that exceeded approximately 7 mm during all but the August 27 pollution event. Fecal contamination at this station on this date was insignificant. It was noted that the FC levels for the bathing area were usually higher than the FC levels observed at CPI-2. This suggested an additional source of fecal contamination. Although some elevated FC levels were observed behind the pavilion (CPI-3), it did not appear that there was a consistent source from the direction of Lake Superior. It appeared that the majority of the fecal bacteria were being washed into the bathing area from the land surrounding the beach. During the summer, the trailer camp directly behind the beach, contained a number of pets. Also, one of the campers told our sampler that one of the other campers emptied his holding tank on the ground instead

TABLE 4. Chippewa Campground Beach 'pollution' events and coincident factors.

EVENT NO	SAMPLE DATE	RAIN (mm)	WIND		WAVE ACTION	BATH LOAD	TURB	WATER TEMP	FC/100 ml		
			DIR	INTENS					BEACH	CPI-2	CPI-3
1	June 5	0.4	on	light	calm	0	5.9	13	602	176	10
	June 6	11.6	on	light	calm	0	2.8	14	337	150	150
2	July 23	38.9	off	light	calm	0	6.0	20	375	370	
3	Aug. 8	30.9	off	light	calm	0	5.1	20	179	160	210
	Aug. 9	12.6	off	light	calm	0	4.7	19	161	180	130
4	Aug. 21	9.1	off	light	calm	0	5.3	20	320	100	10
5	Aug. 27	7.1	off	light	calm	0	8.3	20	175	10	20

of in an approved disposal facility. This was never confirmed. In addition, a small flock of Canada geese were regularly observed on the shore on the far side of the beach. All of these sources may have contributed fecal coliform bacteria to the water of the bathing area.

Similar to Chippewa Beach, the majority of the fecal bacteria found in the bathing area were E.coli. E.coli levels ranged from 10 to 860 per 100 ml. P.aeruginosa was detected infrequently at this beach. Fecal streptococcus bacteria were present in the majority of the beach samples usually ranging from 200 to 600 per 100 ml.

The elevated levels of fecal bacteria in the bathing area appeared to decline quite rapidly following each heavy rainfall. The high levels of FC and E.coli did not persist longer than 24 hours in the bathing area following each rainfall. The water flowing through the bathing area may have helped to reduce the high FC levels faster than might be otherwise expected.

Since the majority of samples were collected on weekday mornings, the extent to which this bathing area was actually used is unknown. However, since the bathing area was quite shallow and the bottom muddy, it is probable that the beach was used predominantly by toddlers and small children who played in the shallows rather than by actual swimmers.

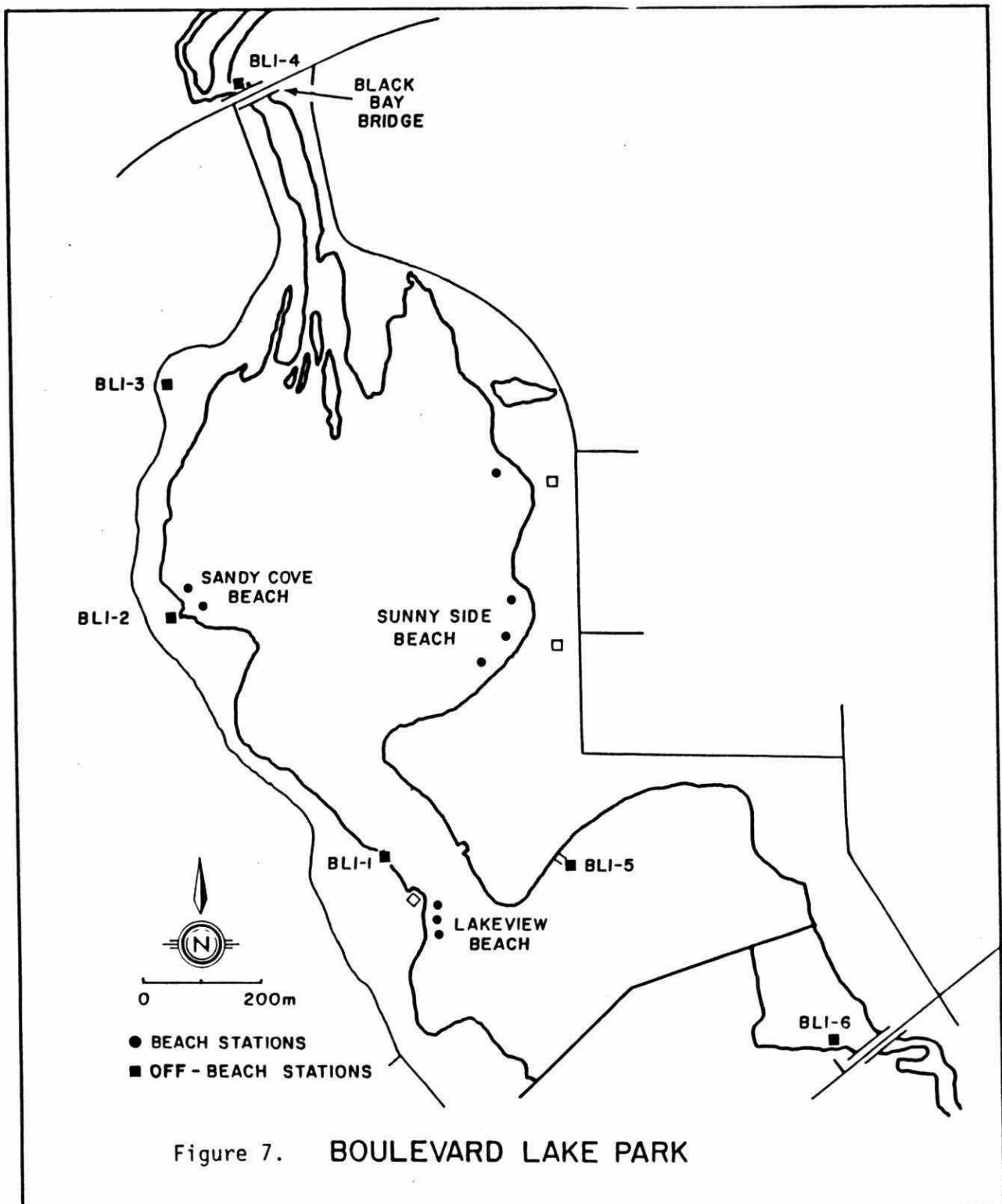
2.4 RECOMMENDATIONS

1. The heavy growths of water plants should be controlled to make the bathing areas at this park more aesthetically pleasing and allow better circulation of water.
2. The relationship between stormwater run-off and a pollution event at Chippewa Beach had several inconsistencies. These should be investigated further.

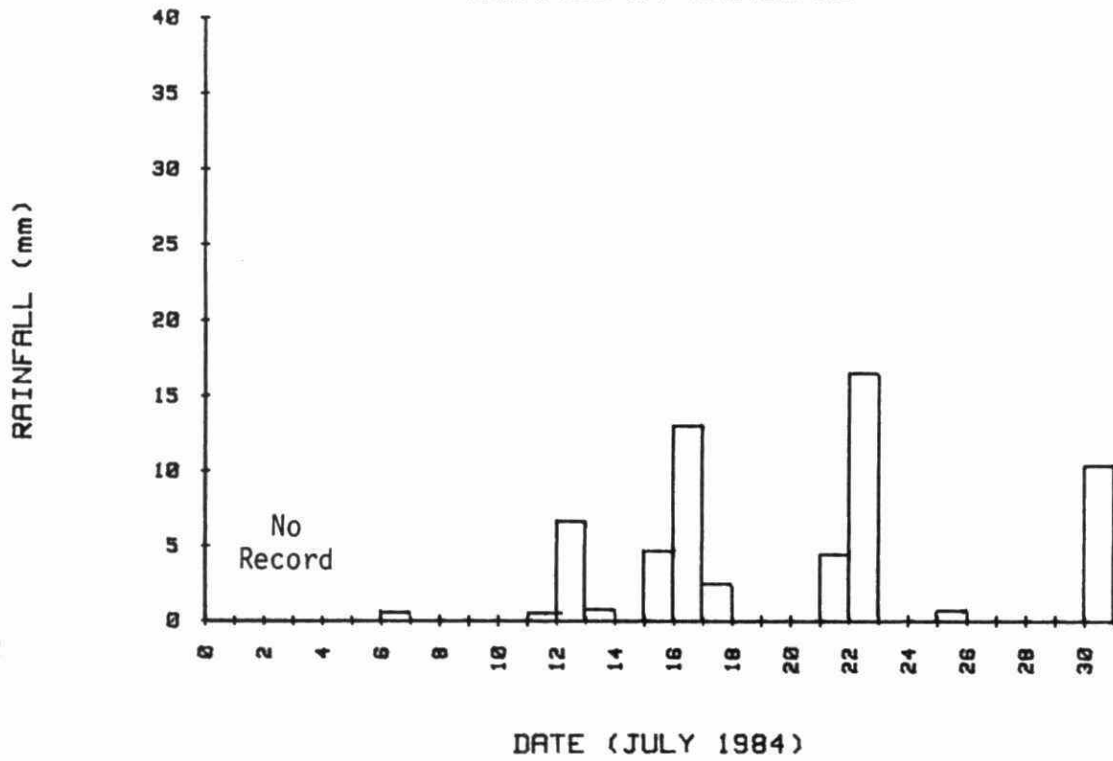


3. BOULEVARD LAKE PARK

Boulevard Lake is a shallow reservoir resulting from a dam across the Current River. The lake and the surrounding park lies entirely within the limits of the City of Thunder Bay (Figure 7). The park is heavily used during the summer for a variety of recreational pursuits. The park contains three distinct bathing areas: Lakeview Beach, Sandy Cove Beach and Sunnyside Beach. Lakeview Beach is the primary bathing area in the park.



RAINFALL AT OLIVER RD



RAINFALL AT OLIVER RD

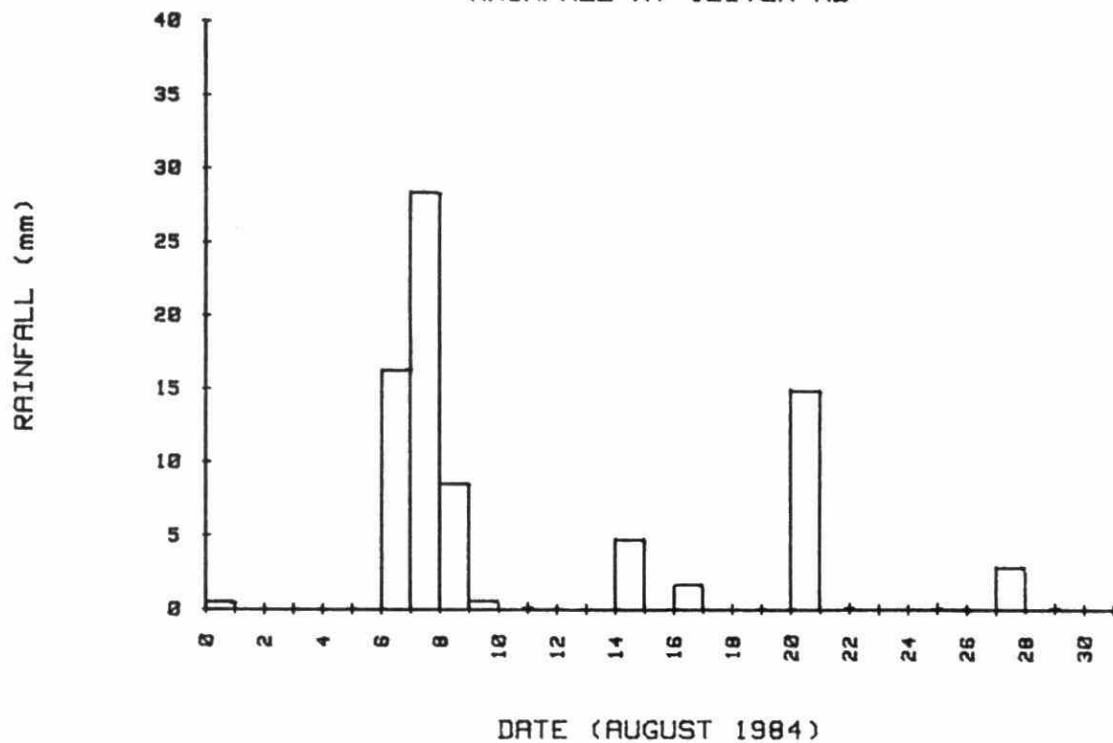


Figure 8. Rainfall recorded from July 6 to August 31, 1984 at Oliver Rd., Thunder Bay.

3.1 RAINFALL DATA

Rain gauging equipment was set up on Oliver Road, approximately 4 km from Boulevard Lake Park. This was not an ideal location for monitoring rainfall at this park, but was the closest location available which would provide both security against vandalism and convenient access for daily readings.

Rainfall was recorded at Oliver Road from July 6 to August 31, 1984. These results are shown in Figure 8.

3.2 LAKEVIEW BEACH

3.2.1 Background

During the summer of 1983, thirteen samples were collected at Lakeview Beach during the thirteen day period beginning on July 22 and ending on August 3, 1983 (1). High levels of fecal coliform bacteria were found in a number of these samples. As a result, this beach was placarded between July 25 and August 5. No other samples were collected from this beach outside this period.

3.2.2 Description

Lakeview Beach lies on the western shore of Boulevard Lake (Figure 7). The bathing area is delineated by a string of buoys (Figure 9). The bottom composition of the bathing area is fine sand and clay that is resuspended into the water only with some difficulty. The beach is sandy and slopes gently toward a breakwall which lies inland of the sand beach. A level, grassy, recreational area lies inland from the breakwall.

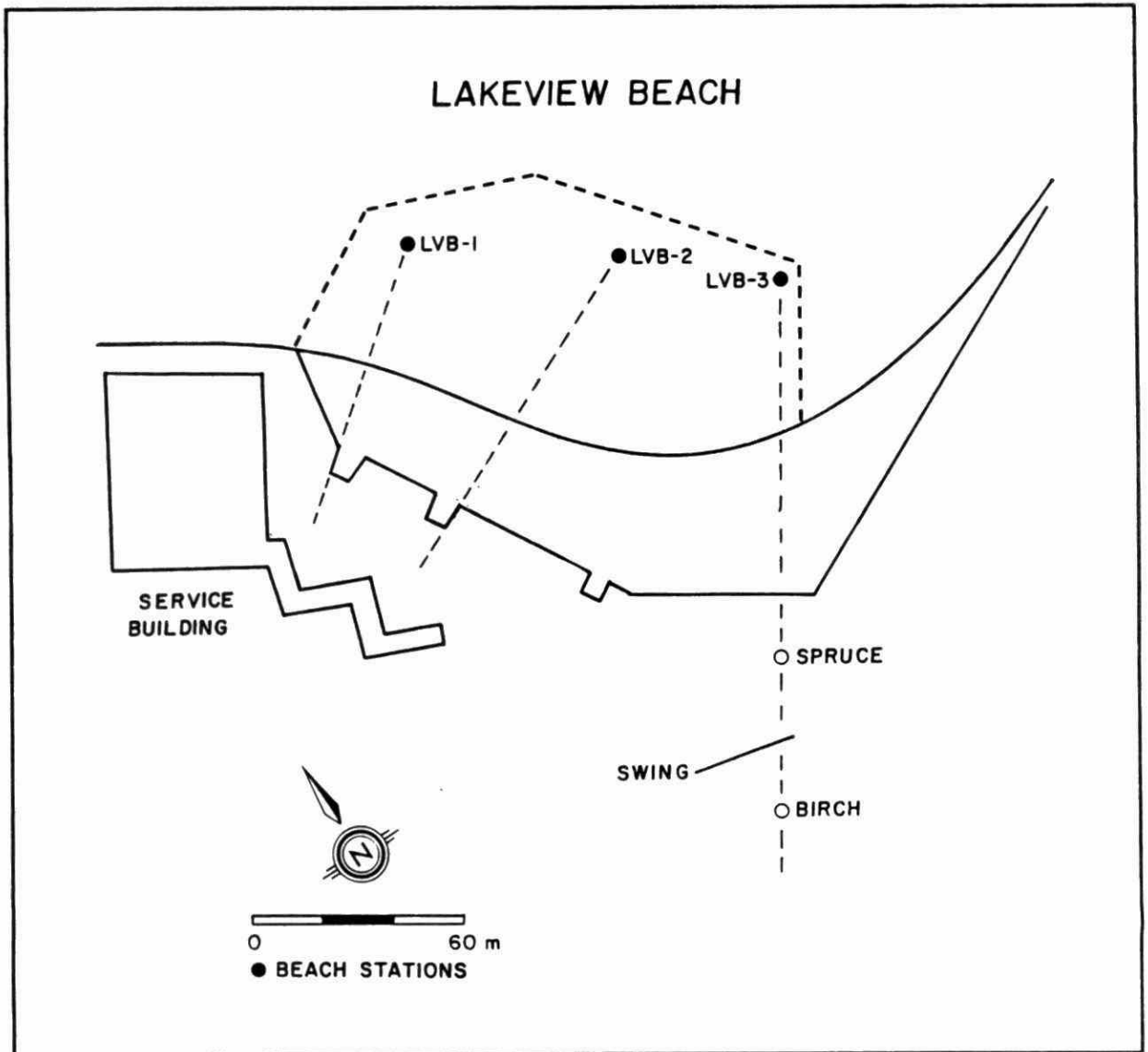


Figure 9. Lakeview Beach.

3.2.3 Sanitary Survey

The sanitary survey conducted on May 28, 1984, at Lakeview Beach revealed a number of pipes, culverts and ditches that emptied into Boulevard Lake. However, only one outfall that was relatively close to Lakeview Beach contained flowing water on May 28. This outfall was a 36" storm sewer which emptied into the lake less than 50 m north of the beach. This storm sewer drained the area near the Lakehead Psychiatric Hospital.

3.2.4 Sampling Stations

Three beach stations were established at evenly spaced points within the bathing area in 1 - 1.5 m of water (Figure 9). These stations were called LVB-1, LVB-2, and LVB-3.

A number of off-beach stations were also established at Boulevard Lake Park (Figure 7). Not all of these stations were necessary to monitor Lakeview Beach but were used in common for all three bathing areas at Boulevard Lake. Station BLI-1 was established at the 36" storm sewer, the outfall closest to Lakeview Beach. Both the inflow (BLI-4) to and the outflow (BLI-6) from Boulevard Lake were also monitored. BLI-5 was a control station established at the end of a dock on the eastern shore of the lake. The other off-beach stations will be described in later sections.

3.2.5 Methods

In June 1984, all beach stations were sampled at least once each week on a weekday morning. In July and August, beach stations were sampled at least twice each week - once on a weekday morning and once on a weekend afternoon. Additional samples were collected following heavy rainfall. Initially, all samples were analyzed for TC, FC, EC, FS and PSA. In mid-July, the bacterial

parameters analyzed on the weekday samples were reduced to FC, EC and PSA. All the bacterial parameters were analyzed on the weekend samples.

3.2.6 Results and Discussion

Lakeview Beach stations LVB-1 to LVB-3 were sampled once per day on twenty-three separate days over the period May 28 to August 31, 1984. No significant differences in the bacteriological data were found between these stations. The fecal coliform seasonal geometric mean for the beach stations was 25 per 100 ml.

During this period, the fecal coliform daily geometric mean of the three beach stations was found to exceed 100 per 100 ml only on August 8, 1984 (Underlined value in Table 5). This event was preceeded by a very heavy rainfall. Lakeview Beach was not placarded at any time throughout the summer of 1984.

The single pollution event recorded on August 8 may be an underestimate of the total number that may have occurred since samples were not collected after each heavy rainfall. Heavy rains (greater than 10 mm) fell at Boulevard Lake in the 24 hours prior to June 6, 11 and 27, July 17, 21 and 31 and August 7, 8 and 21 (Figure 1 and 8). However, samples were only collected on three of these dates: June 6, June 27 and August 8. The effect that the rainfall had on the water quality for the other dates is unknown. It appears probable, however, that the rainfall must be prolonged and quite substantial before a significant effect is seen. For example, fecal coliform levels did not increase on June 27, only increased slightly on June 6 but increased substantially August 8 following two days of heavy rain.

The cause of this single pollution event appeared quite obvious: heavy rainfall flooding the bathing area with stormwater run-off. Bather loading, wind and wave action, water temperature, turbidity, etc. were not unusual on August 8. However, three outfalls

TABLE 5. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT LAKEVIEW BEACH, May 28/84 TO
BOULEVARD LAKE PARK (ALL DATA) Aug 31/84

SAMPLING	FECAL COLIFORM COUNTS PER 100 ML						DAILY		
DATE	BEACH STATION NUMBERS						GEOM.		
YY MM DD	LVB1	LVB2	LVB3				MEAN		
184 5 28	201	201	201				20.01		
184 6 6	101	801	1401				48.21		
184 6 13	701	401	901				63.21		
184 6 20	101	101	101				10.01		
184 6 27	101	101	101				10.01		
184 7 4	101	201	101				12.61		
184 7 8	101	101	201				12.61		
184 7 11	301	101	301				20.81		
184 7 15	301	401	501				39.11		
184 7 18	301	101	401				22.91		
184 7 22	501	201	201				27.11		
184 7 25	101	101	101				10.01		
184 7 29	101	201	801				25.21		
184 8 1	201	201	101				15.91		
184 8 5	101	101	201				12.61		
184 8 6	201	401	301				28.81		
184 8 8	2401	1401	2901				213.61		
184 8 10	501	401	701				51.91		
184 8 12	901	201	401				41.61		
184 8 15	601	601	501				56.51		
184 8 19	101	301	301				20.81		
184 8 22	201	101	101				12.61		
184 8 29	201	301	301				26.21		
GEOM. MEAN	22.91	22.31	30.21						

empty into the west side of Boulevard Lake. The water from the large cement culvert (BLI-1) contained 2100 FC per 100 ml on August 8. This was the highest level of fecal coliform bacteria recorded at this station throughout the summer. Under dry weather conditions, this outfall contained little or no fecal coliforms. The second and third outfalls (BLI-2 and BLI-3), both emptied near Sandy Cove Beach. Fecal coliform levels of 500 and 4600 per 100 ml, respectively, were recorded at these stations on August 8. Additionally, higher than normal levels of fecal coliforms were also found at the Current River inflow to Boulevard Lake. A value of 210 FC per 100 ml was observed at station BLI-4 on August 8.

The major component of the fecal coliform bacteria observed in the bathing area and the various outfalls on August 8 was E.coli. At Lakeview Beach, the August 8th E.coli geometric mean was 190 per 100 ml. E.coli levels of 1800, 200 and 4600, respectively, were recorded at the three outfalls noted above. The Current River contained 210 E.coli per 100 ml.

Sixty-nine Lakeview Beach samples were analyzed for Pseudomonas aeruginosa. During the months of June, July and August, 1984, this organism was present in 20%, 87%, and 93% of the beach samples. This trend toward the increasing presence of PSA was paralleled by increasing water temperature. The highest water temperatures of the summer (25°C) were recorded during the first week of August. The PSA levels in these samples ranged from 1 to 21 per 100 ml. In July, 17% of the beach samples contained PSA at levels greater than 10 per 100 ml. In August, this percentage rose to 27%.

The PSA in the bathing area at Lakeview Beach may have come from a variety of sources. PSA was present occasionally in the three outfalls along the western shore of Boulevard Lake. However, with one exception on August 8, the levels were generally very low. On August 8, a level of greater than 150 PSA per 100 ml

was recorded at BLI-1. This may also have occurred earlier in the summer but there are no data to support this premise since BLI-1 was not routinely monitored following each heavy rain. In addition to the outfalls, PSA was recovered several times from the Current River during August.

To assess the effect of bather loading, eight sets of bathing area samples were collected between noon and 1:30 p.m. on a Sunday or holiday during July and August. No significant differences in the bacteriological data were observed between these weekend or holiday afternoon samples and the weekday morning samples. Therefore, it appeared that the presence of bathers in the water at Lakeview Beach did not have an immediate impact on the PSA levels. However, it is interesting to note that the highest PSA levels of the summer were recorded on August 6, Civic Holiday.

3.3 SANDY COVE BEACH

3.3.1 Background

During the summer of 1983, no water samples were collected from the bathing area at Sandy Cove Beach. Therefore, in 1983, the water quality at this beach was unknown. However, since Sandy Cove Beach is on a continuous water body with Lakeview Beach, it is probable that elevated fecal coliform levels may also have occurred at Sandy Cove Beach at the same time that high levels were observed at Lakeview Beach.

3.3.2 Description

Sandy Cove Beach is a small bathing area located on the western shore of Boulevard Lake, north of Lakeview Beach (Figure 7). The bottom composition of the bathing area is mainly sand along with some mud. The beach is a sandy floodplain, resulting from the erosion of the high banks on either side of the beach (Figure 10). The beach is bisected by a ditch leading to a partially buried wooden culvert.

3.3.3 Sanitary Survey

The sanitary survey conducted on May 28, 1984, at Sandy Cove Beach revealed two outfalls that might have an impact on the water quality of the bathing area at this beach. One was the ditch which bisected the beach. On May 28th, this ditch contained continuously flowing water, the source of which, was the wooded area inland from the beach. The other outfall was a culvert north of Sandy Cove Beach, located between the beach and the Current River. On May 28, water was also flowing continuously from this culvert. The source of the water from this outfall was a man-made channel beyond the wooded area behind a housing development.

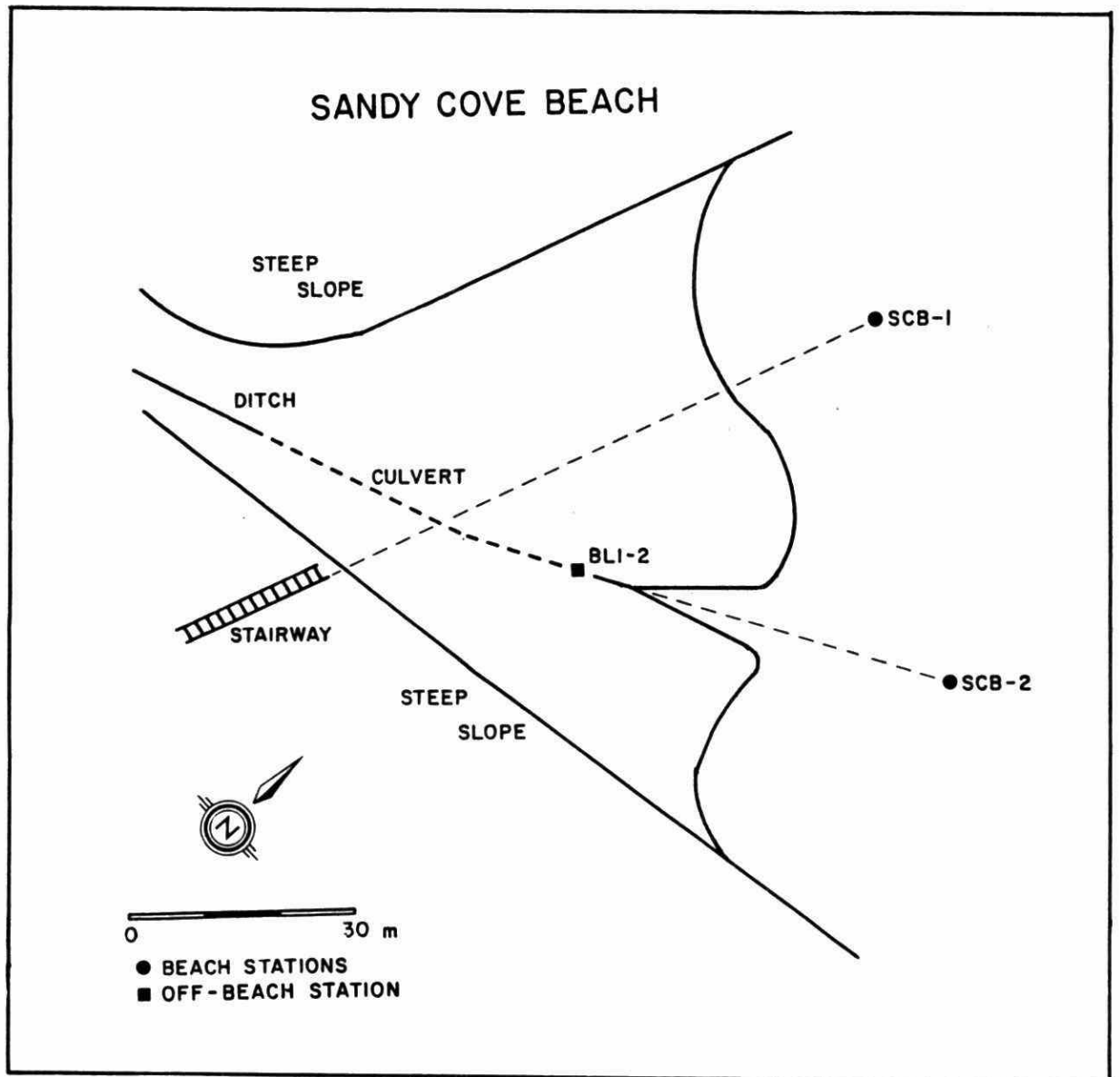


Figure 10. Sandy Cove Beach.

TABLE 6. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT SANDY COVE BEACH, BOULEVARD LAKE PARK (ALL DATA) May 28/84 TO Aug 31/84

SAMPLING DATE YY MM DD	FECAL COLIFORM COUNTS PER 100 ML BEACH STATION NUMBERS					DAILY GEOM. MEAN		
	SCB1	SCB2						
84 5 28	20	12				15.5		
84 6 6	10	40				20.0		
84 6 13	10	20				14.1		
84 6 20	10	30				17.3		
84 6 27	10	10				10.0		
84 7 4	30	40				34.6		
84 7 8	20	10				14.1		
84 7 11	20	20				20.0		
84 7 15	40	90				60.0		
84 7 18	10	40				20.0		
84 7 22	10	10				10.0		
84 7 25	20	10				14.1		
84 7 29	40	30				34.6		
84 8 1	30	10				17.3		
84 8 5	10	10				10.0		
84 8 6	10	10				10.0		
84 8 8	350	130				213.3		
84 8 10	30	30				30.0		
84 8 12	20	10				14.1		
84 8 15	10	10				10.0		
84 8 22	10	60				24.5		
84 8 29	20	20				20.0		
GEOM. MEAN	18.7	21.0						

3.3.4 Sampling Stations

Two beach stations were established within the bathing area in 1-1.5 m of water (Figure 10). These stations were called SCB-1 and SCB-2. In addition to the off-beach stations noted for Lakeview Beach, section 3.2.5, two other off-beach stations were established. Station BLI-2 was established at the outlet end of the wooden culvert that bisected the beach. Station BLI-3 was established at the outfall from the culvert located between Sandy Cove Beach and the Current River mouth (Figure 7).

3.3.5 Methods

The methods used for the collection and analysis of samples at Sandy Cove Beach were identical to those used at Lakeview Beach (Section 3.2.5).

3.3.6 Results and Discussion

Sandy Cove Beach stations SCB-1 and SCB-2 were sampled once per day on twenty-two separate days over the period May 28 to August 31, 1984. No significant differences in the bacteriological data were found between the stations. The fecal coliform seasonal geometric mean for the two beach stations was 20 per 100 ml.

During this period, the fecal coliform daily geometric mean of the two beach samples was found to exceed 100 per 100 ml only on August 8, 1984 (underlined value in Table 6). Sandy Cove Beach was not placarded at any time throughout the summer of 1984.

As was the case with Lakeview Beach, this event followed a very heavy, prolonged rainfall. The FC mean may have exceeded 100 per 100 at other times but gone undetected since samples were collected at this beach within 24 hours of a rainfall that exceeded

10 mm only on only three dates during the summer. Elevated levels of fecal coliforms were not observed on June 6 or on June 27, 1984. However, on August 8, the fecal coliform daily geometric mean reached 213 per 100 ml. By August 10, the fecal coliform level had returned to baseline values.

The cause of the single pollution event at Sandy Cove Beach again appears obvious: heavy, prolonged rainfall that resulted in stormwater run-off reaching the bathing area. In addition to the Current River, two outfalls emptied at or near Sandy Cove Beach. One of these outfalls (BLI-2) emptied directly onto the beach. A fecal coliform level of 500 per 100 ml was recorded at this station on August 8. The other outfall (BLI-3) emptied just north of Sandy Cove Beach. This outfall, which flowed intermittently during the summer, contained 4600 FC per 100 ml on August 8. The net result of this, in addition to any contaminants from the beach itself, or the Current River, was an elevated fecal coliform level in the bathing area.

E.coli was usually present at varying levels in the beach samples whenever fecal coliforms were found. Fecal streptococci were recovered from all beach samples at levels ranging from 8 to 1500 per 100 ml.

Forty beach samples were analyzed for P.aeruginosa. During the months of June, July and August, this organism was present in 50%, 56% and 75%, respectively, of the beach samples collected. All P.aeruginosa levels were less than 10 per 100 ml except on August 6 (Civic Holiday), when a level of 17 PSA per 100 ml was observed.

3.4 SUNNYSIDE BEACH

3.4.1 Background

During the summer of 1983, only two samples were collected from the bathing area at Sunnyside Beach. Both of these samples contained FC levels above 100/100 ml. Sunnyside Beach was not placarded at that time. Due to the lack of data, it is not possible to determine the source of the 1983 bacterial contamination.

3.4.2 Description

Sunnyside Beach is located on the north-eastern shore of Boulevard lake across from Sandy Cove Beach (Figure 7). The bottom composition of the bathing area is sand and gravel. The shoreline is curved and sandy and backed by a grassy slope. This beach is the second most popular at Boulevard Lake Park.

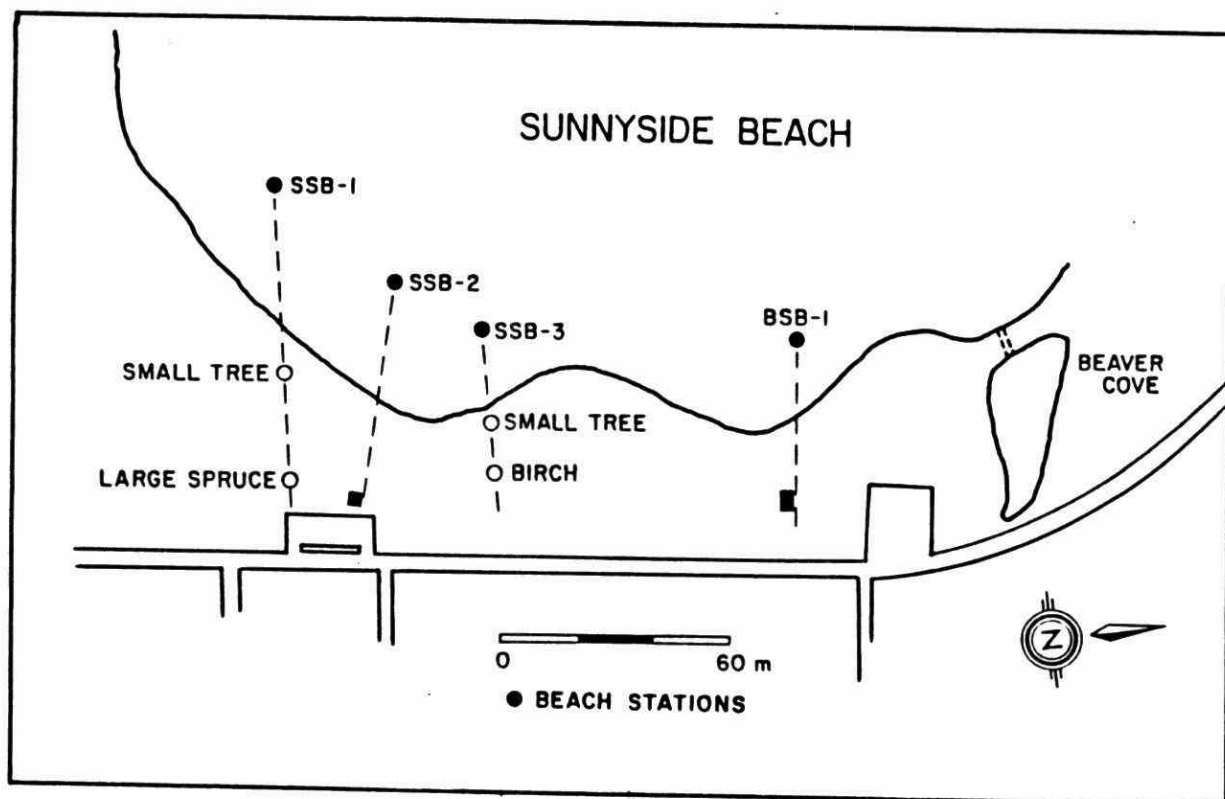


Figure 11. Sunnyside Beach.

3.4.3 Sanitary Survey

The sanitary survey conducted on May 28, 1984, did not reveal any outfalls near Sunnyside Beach. However, there were several dry ditches near the beach that could carry run-off to the lake following a heavy rain. A small stagnant lagoon called Beaver Cove is located just north of the beach (Figure 11). This lagoon is connected to the lake by a large culvert. On May 28th, a net flow of water into the lake was not observed.

3.4.4 Sampling Stations

Three beach stations were established at evenly spaced points within the bathing area in 1-1.5 m of water (Figure 11). These stations were called SSB-1, SSB-2, and SSB-3. One off-beach station (BSB-1) was also established just north of Sunnyside Beach. This station was established at this point since it appeared that a number of bathers also used this area for bathing.

3.4.5 Methods

The methods used for the collection and analysis of samples from Sunnyside Beach were identical to that used for Lakeview Beach (Section 3.2.5).

3.4.6 Results and Discussion

Sunnyside Beach stations SSB-1, SSB-2, SSB-3, and off-beach station BSB-1 were sampled once per day on twenty-three separate days over the period May 28 to August 31, 1984. No significant differences in the bacteriological data were found between these stations. The seasonal fecal coliform geometric mean for the beach stations was 24 per 100 ml.

TABLE 7. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT SUNNYSIDE BEACH, BOULEVARD LAKE PARK (ALL DATA) May 28/84 TO Aug 31/84

SAMPLING DATE YY MM DD	FECAL COLIFORM COUNTS PER 100 ML BEACH STATION NUMBERS				DAILY GEOM. MEAN		
	SSB1	SSB2	SSB3	BSB1			
184 5 28	28	12	44	12	20.5		
184 6 6	20	40	50	110	45.8		
184 6 13	30	60	50	20	36.6		
184 6 20	10	10	10	10	10.0		
184 6 27	10	10	10	50	15.0		
184 7 4	80	30	10	10	22.1		
184 7 8	50	20	20	10	21.1		
184 7 11	20	50	20	40	29.9		
184 7 15	40	110	50	80	64.8		
184 7 18	10	20	30	50	23.4		
184 7 22	20	20	10	20	16.8		
184 7 25	20	10	10	10	11.9		
184 7 29	10	40	40	10	20.0		
184 8 1	10	10	30	10	13.2		
184 8 5	40	30	10	10	18.6		
184 8 6	20	10	30	10	15.7		
184 8 8	40	110	50	200	81.4		
184 8 10	30	30	40	50	36.6		
184 8 12	40	30	10	10	18.6		
184 8 15	100	70	40	200	86.5		
184 8 19	10	20	10	50	17.8		
184 8 22	10	80	50	60	39.4		
184 8 29	10	10	10	10	10.0		
GEOM. MEAN	22.1	26.4	22.2	25.6			

During this period, the fecal coliform daily geometric mean of the three beach stations was never found to exceed 100 per 100 ml (Table 7). A slightly increased fecal coliform geometric mean was observed on August 8. However, it did not exceed 100/100 ml. The lower fecal coliform levels observed at Sunnyside Beach were an indication that the contaminants from the outfalls on the western shore of Boulevard Lake, did not reach this bathing area.

Sixty-six beach samples were analyzed for P.aeruginosa. During the months of June, July and August, this organism was present in 0%, 66% and 90%, respectively, of the beach samples collected. As was the case with the other beaches on Boulevard Lake, PSA was present in the highest percentage of samples in August. During the summer of 1984, only four samples from Sunnyside Beach were found to contain PSA at a level greater than 10 per 100 ml. Three of these occurred on a single sampling run. The beach samples collected on July 25 contained 29, 14 and 21 PSA per 100 ml. The cause of these higher levels on that date is unknown. None of the other factors recorded were unusual.

3.5 RECOMMENDATIONS

1. The effect of rainfall on the various outfalls and bathing areas should be more clearly defined by additional sampling in 1985.
2. The levels of P.aeruginosa at all of the bathing areas on Boulevard Lake should be monitored in 1985.

4. HAZELWOOD LAKE CONSERVATION AREA

Hazelwood Lake Conservation Area is located on Hazelwood Lake approximately 25 km directly north of the City of Thunder Bay. This conservation area is administered by the Lakehead Region Conservation Authority (LRCA). The conservation area is used for a variety of recreational pursuits.

4.1 RAINFALL MONITORING

Rain gauging equipment was set up at Hazelwood Lake Conservation Area near the residence (Figure 13) on July 3, 1984. Readings were taken each morning. Readings were not usually taken during the weekend. These values were estimated based on the volume of water collected on the following Monday morning. The results are shown in Figure 12.

4.2 HAZELWOOD BEACH

4.2.1 Background

During the summer of 1983, samples were collected from a single beach station every second week, by LRCA staff. These samples were analyzed at the MOE Laboratory in Thunder Bay for TC, FC and PSA. In August, 1983, this beach was placarded for a three day period as a result of elevated fecal coliform levels. High E.coli levels were observed in additional samples collected at that time. However, these additional samples did not provide sufficient data to determine the source of the contamination.

4.2.2 Description

Hazelwood Beach is a small bathing area located at the end of a long narrow bay on Hazelwood Lake (Figure 13). The bottom composition of the bathing area is sand with some mud and other debris. The shoreline

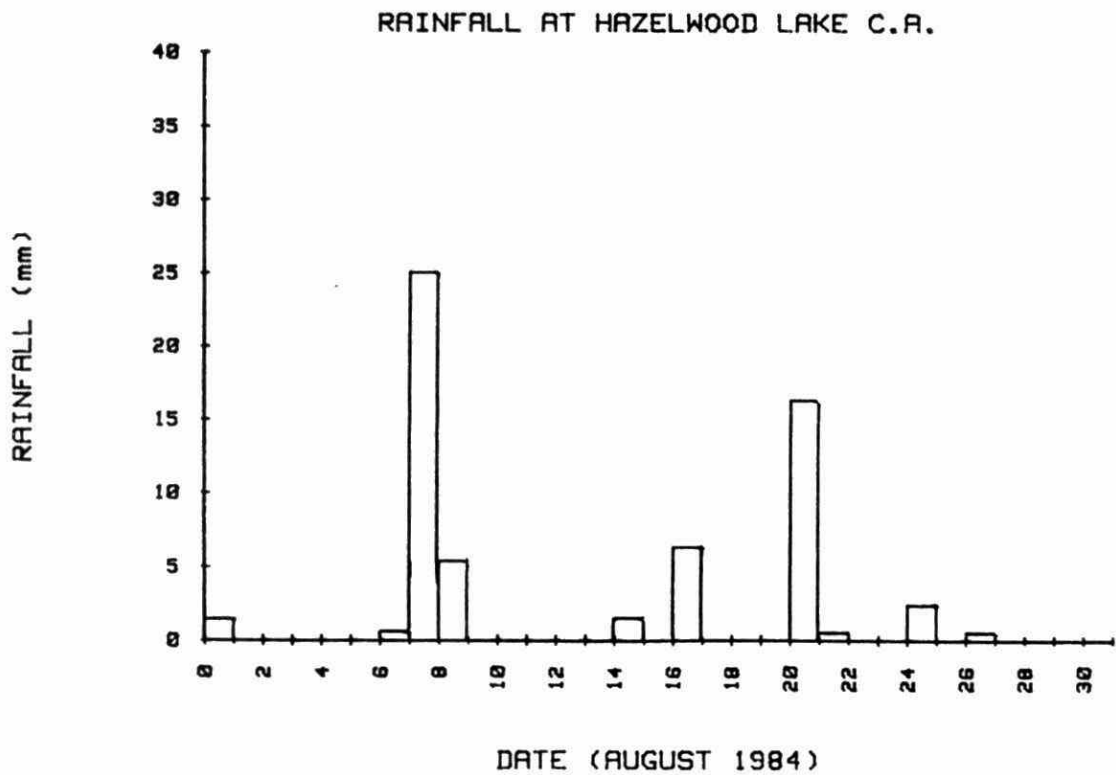
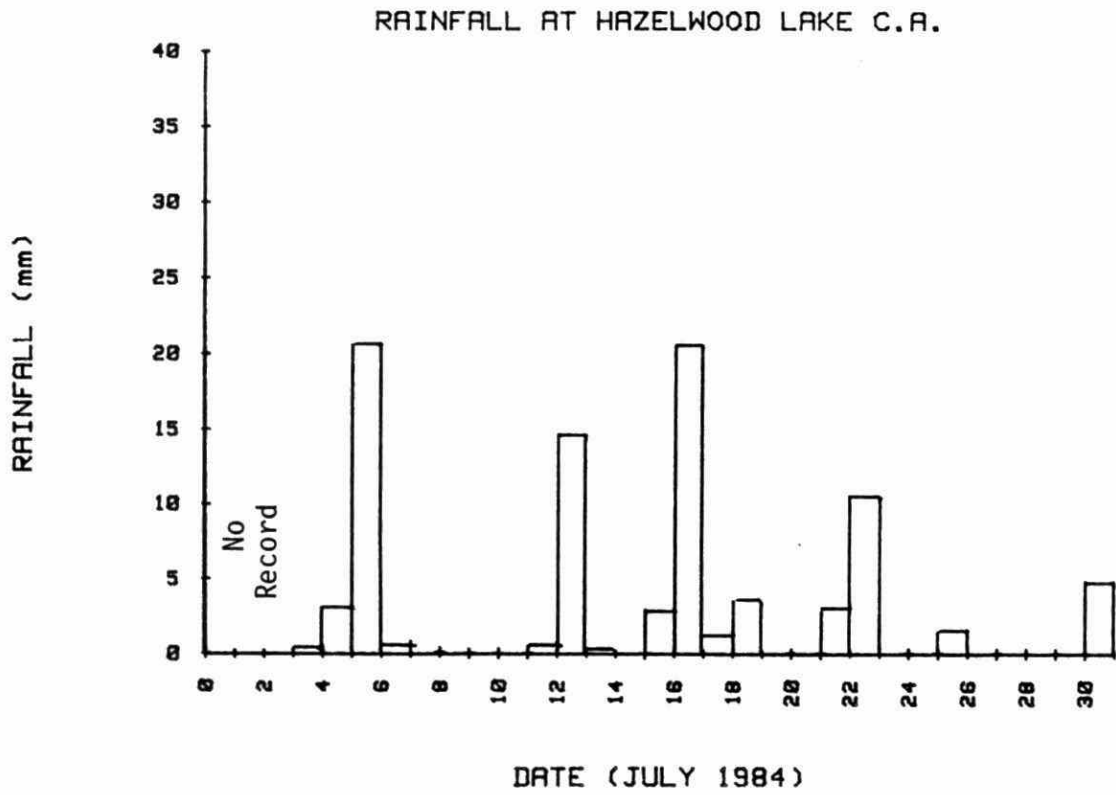


Figure 12. Rainfall recorded at Hazelwood Lake Conservation Area from July 4 to August 27, 1984.

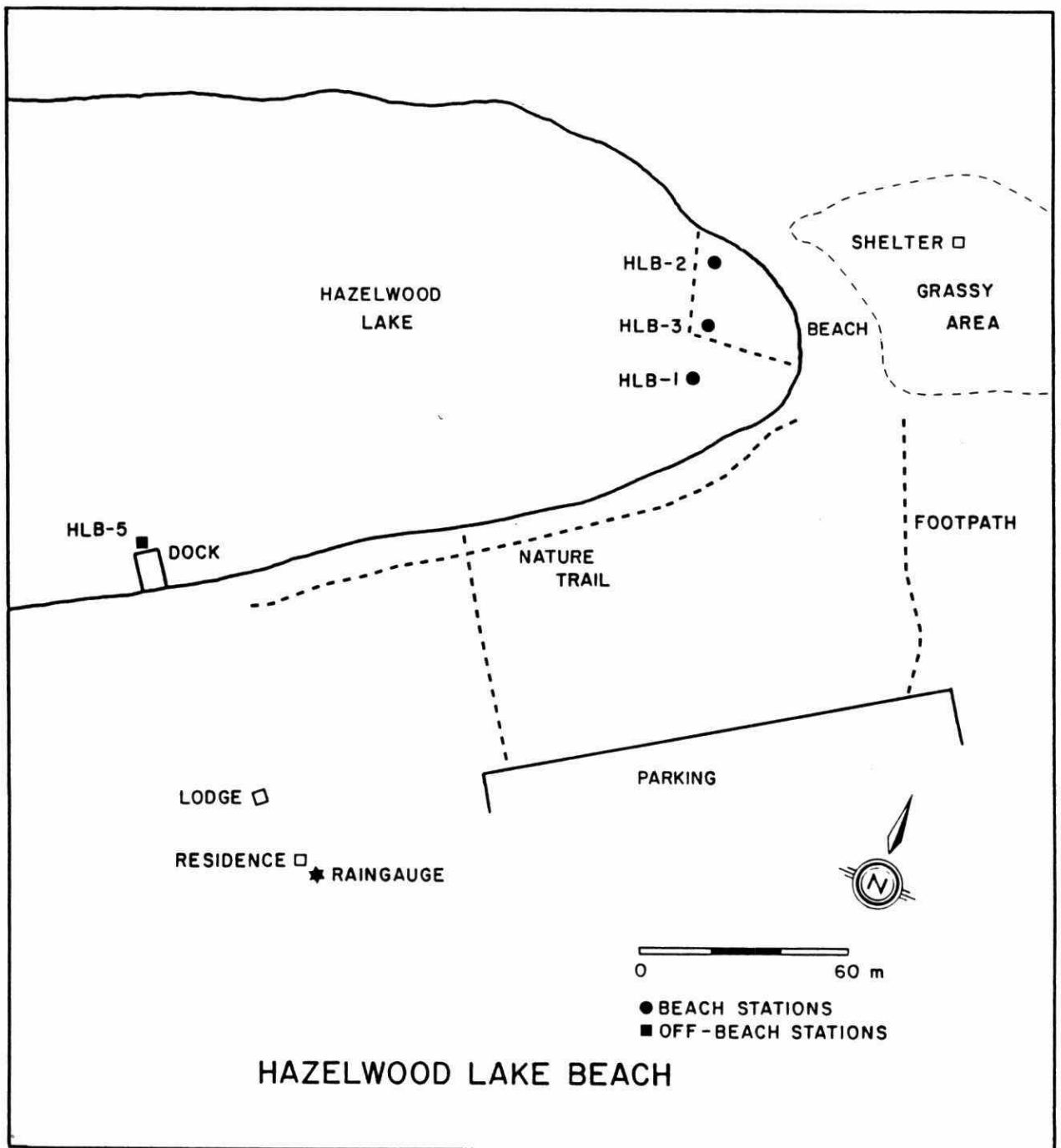


Figure 13. Hazelwood Beach.

of the beach curves around the bathing area. The beach is sandy and slopes gently upward to a grassy, open area which is surrounded by shrubs and trees.

4.2.3 Sanitary Survey

Due to the isolated location of Hazelwood Beach a sanitary survey was not considered necessary prior to the bathing season. No outfalls are located near the beach.

4.2.4 Sampling Stations

Initially, two beach stations were established within the bathing area in 1-1.5 m of water (Figure 13). These stations were HLB-1, and HLB-2. However, in early July, as a result of a strike by employees of the City of Thunder Bay, the day camp previously held at Chippewa Beach was moved to Hazelwood Beach. To outline the bathing area, a buoy line was set up by the day camp staff. Station HLB-1 was outside of this line, while Station HLB-2 was inside. Therefore, an additional beach station called HLB-3 was established inside the bathing area.

One off-beach station (HLB-5) was established as a control station. This station was located in the bay at the end of a small dock approximately 100 m from the bathing area (Figure 13).

4.2.5 Methods

In June 1984, prior to the establishment of the day camp at Hazelwood Beach, weekly samples were collected in the morning from HLB-1 and HLB-2 by LRCA staff. On July 3, following the establishment of the day camp and the additional beach station, the sampling frequency was increased to daily samplings during each weekday. To determine the effect of bather load, on July 11,

and continuing until the end of August, the sampling frequency was again increased to morning and afternoon collections. The morning samples were generally collected before the children started bathing while the afternoon samples were collected during or shortly after the children stopped bathing. Samples were collected by LRCA or day-camp staff. All samples were analyzed for TC, FC, EC, FS and PSA throughout the summer.

4.2.6 Results and Discussion

During the period June 1 to August 31, 1984, one hundred and sixty-six water samples were collected from Hazelwood Beach stations HLB-1, HLB-2 and HLB-3. The sample results from these three stations were divided into two groups: results of samples collected in the morning, and results of samples collected in the afternoon. Since only stations HLB-2 and HLB-3 were located in the immediate bathing area, only the results from these stations were used to calculate FC geometric means.

Using only the results from the samples collected in the morning, no significant differences in the bacteriological results were found between stations HLB-2 and HLB-3. The FC daily geometric mean of the two beach stations for the morning samples were never found to exceed 100 per 100 ml (Table 8). The seasonal FC geometric mean for the two beach stations for morning samples was 9 per 100 ml. In the morning, the bathing water quality was excellent; fecal coliform bacteria were not detected in a number of the samples.

Similarly, using only the results of samples collected in the afternoon, no significant differences in the bacteriological results were found between these two stations. The FC daily geometric means of the two beach stations for the afternoon samples was found to exceed 100 per 100 ml on three occasions: July 31, August 2, and August 24 (Underlined values in Table

TABLE 8. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT HAZELWOOD BEACH, HAZELWOOD LAKE CONS. AREA (a.m. DATA ONLY)

Jun 1/84 TO
Aug 31/84

SAMPLING DATE YY MM DD	FECAL COLIFORM COUNTS PER 100 ML BEACH STATION NUMBERS				DAILY GEOM. MEAN		
	HLB2	HLB3					
184 6 4	101				10.01		
184 6 11	101				10.01		
184 6 18	101				10.01		
184 6 25	101				10.01		
184 7 3	101	101			10.01		
184 7 5	41	81			5.71		
184 7 6	441	41			13.31		
184 7 9	101	41			6.31		
184 7 10	101	101			10.01		
184 7 11	101	101			10.01		
184 7 12	41	101			6.31		
184 7 16	101	41			6.31		
184 7 17	201	201			20.01		
184 7 18	101	101			10.01		
184 7 19	101	101			10.01		
184 7 20	101	101			10.01		
184 7 23	121	201			15.51		
184 7 24	101	101			10.01		
184 7 25	1121	101			33.51		
184 7 26	41	81			5.71		
184 7 27	101	101			10.01		
184 7 30	101	161			12.61		
184 7 31	121	81			9.81		
184 8 1	101	41			6.31		
184 8 2	101	101			10.01		
184 8 3	101	101			10.01		
184 8 7	81	81			8.01		
184 8 13	101	101			10.01		
184 8 16	101	41			6.31		
184 8 17	41	81			5.71		
184 8 20	101	101			10.01		
184 8 23	101	101			10.01		
184 8 27	101	101			10.01		
GEOM. MEAN	10.31	8.81					

TABLE 9. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT HAZELWOOD BEACH, HAZELWOOD LAKE CONS. AREA (p.m. DATA ONLY)

Jun 1/84 TO
Aug 31/84

SAMPLING	FECAL COLIFORM COUNTS PER 100 HL					DAILY		
DATE	BEACH STATION NUMBERS					GEOM.		
YY MM DD	HLB2	HLB3				MEAN		
184 7 4	101	101				10.01		
184 7 11	201	301				24.51		
184 7 16	101	2301				48.01		
184 7 18	401	301				34.61		
184 7 19	101	101				10.01		
184 7 20	361	321				33.91		
184 7 24	81	161				11.31		
184 7 26	801	601				69.31		
184 7 27	101	41				6.31		
184 7 29	201	121				15.51		
184 7 31	1481	1241				135.51		
184 8 1	301	1401				64.81		
184 8 2	2801	6001				409.91		
184 8 3	101	101				10.01		
184 8 5	101	101				10.01		
184 8 6	601	101				24.51		
184 8 8	301	401				34.61		
184 8 13	201	81				12.61		
184 8 14	81	121				9.81		
184 8 15	401	601				49.01		
184 8 16	41	121				6.91		
184 8 17	101	101				10.01		
184 8 20	101	301				17.31		
184 8 21	101	201				14.11		
184 8 22	101	101				10.01		
184 8 23	161	81				11.31		
184 8 24	6001	1641				313.71		
GEOM. MEAN	22.11	25.21						

9). Hazelwood Beach was not placarded at any time throughout the summer of 1984.

E.coli levels were also elevated on these dates, being only slightly lower than the FC levels. No coincident increases in the levels of PSA were observed. The seasonal FC geometric mean for the afternoon samples was 23.6 per 100 ml. This value was slightly elevated from the morning seasonal mean but was not significantly different.

The three afternoon 'pollution' events appeared to be directly associated with bather loading. However, no direct relationship was found between the number of bathers and the FC or E.coli levels observed. The number of children bathing on the dates that the fecal coliform mean exceeded 100 was not necessarily larger than that recorded on a number of the other dates during the summer. None of the other factors such as water temperature, wind, wave action, etc, were unusual in any respect on those dates. Indeed, rainfall did not affect the bacteriological water quality of Hazelwood Beach throughout the summer. The bacterial levels of samples collected at the control station, approximately 100 m from the bathing area, were uniformly low for both morning and afternoon sets of samples. Only one PSA value was inexplicably elevated. This occurred on the afternoon of August 13, coincident with the extremely high levels of PSA observed in the bathing area. FC and E.coli levels were very low in the morning of the same day for those same stations, indicating that a new factor was introduced between the morning sampling run and the afternoon sampling run. The FC and E.coli levels returned to baseline by the following morning.

High PSA levels also appeared to be associated with bather loading. PSA levels were dramatically increased in the afternoon samples (Figure 14). For example, on August 13, 1984, at station HLB-2, the morning PSA level was less than 1 per 100 ml while

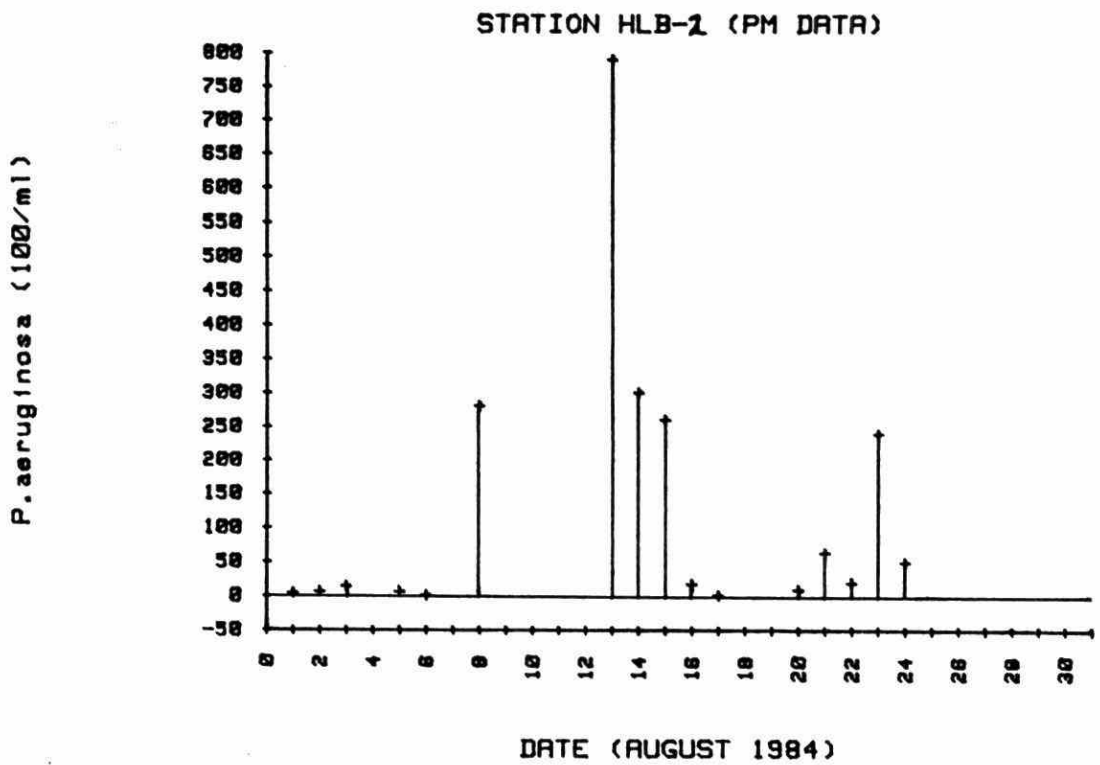
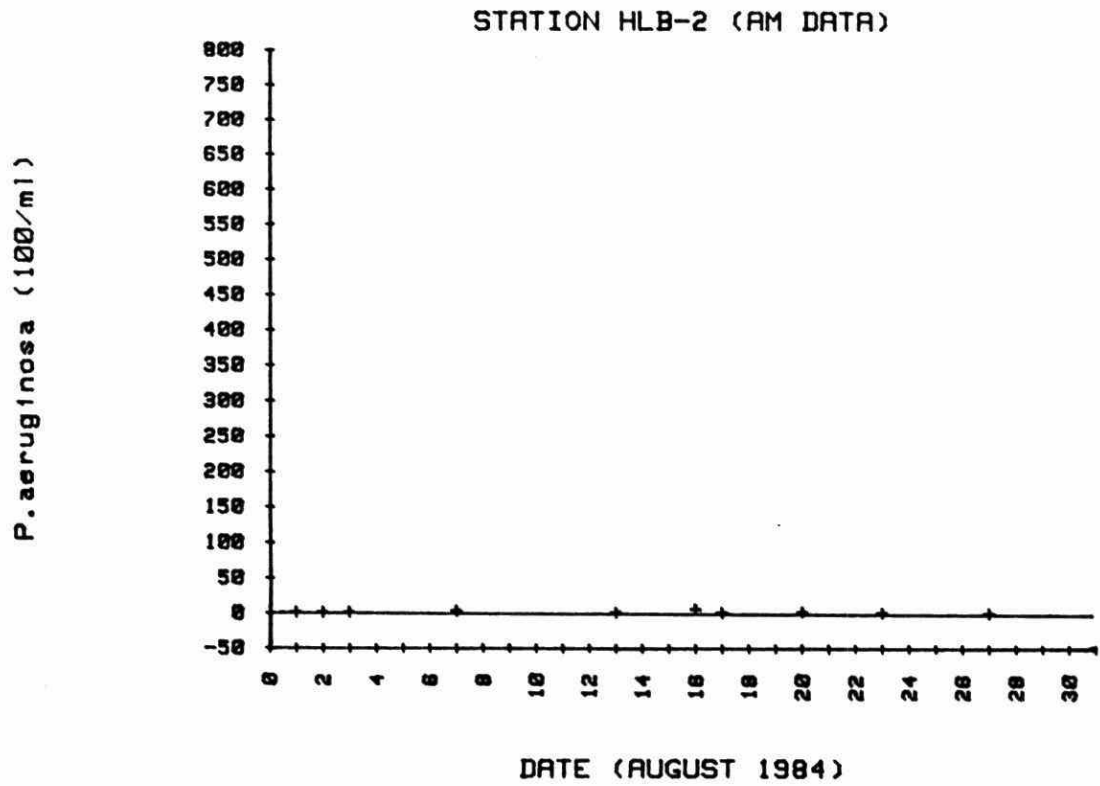


Figure 14. Comparison of AM and PM P.aeruginosa levels at station HLB-2, Hazelwood Beach, August, 1984.

the afternoon level was 790 per 100 ml. The August 13th PSA geometric mean of the two beach stations was approximately 700 per 100 ml. During the summer, PSA was present in the bathing area in approximately 40% of the morning samples. However, only 6% of the morning samples contained 10 or more PSA per 100 ml. In the afternoon more than 90% of the samples were found to contain PSA. Approximately, 74% of these samples contained 10 or more PSA per 100 ml. Fourteen samples contained PSA levels higher than 100 per 100 ml. Again, no direct numerical relationship was observed between the number of bathers and the PSA levels. PSA levels were simply often higher in the afternoon when bathers were present.

This inability to find a direct numerical relationship between bather loading and elevated bacterial levels may have been caused in part by inconsistent sample collection and recording of field observations. At Hazelwood Beach, multiple samplers were involved in the sample collection. Because of this, unfortunately, all of the field observations necessary were not consistently recorded. In addition, the samples were not always collected at the ideal times to determine the effect of bather loading. Some morning samples were collected after the children were already in the water while some afternoon samples were collected after the children had left the water. As a consequence, data interpretations were more difficult.

The average turbidity of the samples collected in the afternoon from the bathing area was increased substantially. For example, at station HLB-3, the average turbidity increased by more than seven times from 0.65 F.T.U. in the morning to 4.6 F.T.U. in the afternoon. The morning value was identical to the average turbidity observed at the control station, HLB-5. However, turbidity could not be used to predict the presence of high PSA, FC or E.coli levels since the high bacterial levels did not always occur when the turbidity was also high.

During the summer of 1984, on the weekdays, the bathers at Hazelwood Beach were almost exclusively children attending the series of day camps. Elevated levels of PSA, FC and E.coli were observed when the day-camp bathers were present. Because these elevated bacterial levels were directly attributable to bather loading, it appeared that the bathing area at Hazelwood Beach was too small to adequately accommodate the large number of children that participated in the bathing activities of the day-camp program.

To determine whether or not the elevated bacterial levels were associated exclusively with the heavy use by the children of the day-camp program, two sampling runs were made when these children were not present. Samples were collected in the afternoon on Sunday, August 5, and Monday, Civic Holiday, August 6. Some bathers were in the water on both dates. Of the six samples collected from the three beach stations, HLB-1, 2, and 3, PSA was present in three samples on August 5 and totally absent August 6. Slightly elevated FC and E.coli levels were observed in one sample on August 6. Whether or not these bacteria were simply survivors from the day-camp bathers is unknown. Nevertheless, it appears that weekend bathers were also exposed to some slightly elevated levels of PSA. The next set of samples, collected on the afternoon of August 8 when day-camp children were present, contained PSA at a level of approximately 300 per 100 ml.

4.3 RECOMMENDATIONS

1. It is recommended that a bathing area larger than that available at Hazelwood Beach be used by the day-camp program in future.
2. The water quality of the beach selected for the day-camp program in 1985 should be monitored closely.

5. CASCADES CONSERVATION AREA

The Cascades Conservation Area is located on the Current River within the boundary of the City of Thunder Bay, upstream of Boulevard Lake Park. This area is used only to a limited degree for bathing.

5.1 CASCADES SWIMMING AREA

5.1.1 Background

The bacterial water quality of the Current River at the Cascades Conservation Area has been monitored for several years. Samples are collected weekly by LRCA staff. The water quality has been good in the past and the area has never been placarded. Sample results from the two stations on this river provided additional control data, useful in the 1984 study of the Boulevard Lake beaches.

5.1.2 Description

The main bathing area at the Cascades Conservation Area is the small pool below the rapids on the Current River. However, bathing may take place at any point in the long series of rapids upstream of the pool. For this reason, a diagram of the area is not included.

5.1.3 Sanitary Survey

A sanitary survey was not considered necessary for this isolated area.

5.1.4 Sampling Stations

Two sampling stations were established: CR-1 and CR-2. Station CR-1 was located at the top of the rapids on the Current River while CR-2 was located in the pool at the bottom of the rapids. No off-beach stations were necessary.

TABLE 10. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT CASCADES
CONSERVATION AREA (ALL DATA)

Jun 1/84 TO
Aug 31/84

SAMPLING DATE YY MM DD	FECAL COLIFORM COUNTS PER 100 ML BEACH STATION NUMBERS					DAILY GEOM. MEAN		
	CR1	CR2						
184 6 4	24	28				25.9		
184 6 11	20	24				21.9		
184 6 18	8	12				9.8		
184 6 25	8	4				5.7		
184 7 3	16	8				11.3		
184 7 9	20	72				37.9		
184 7 16	44	48				46.0		
184 7 23	64	24				39.2		
184 7 30	52	40				45.6		
184 8 7	96	136				114.3		
184 8 13	64	64				64.0		
184 8 20	36	96				58.8		
184 8 27	68	60				63.9		
GEOM. MEAN	30.7	32.4						

5.1.5 Methods

All samples were collected on a weekday morning once per week throughout the summer. All samples were analyzed for TC, FC, EC, FS and PSA.

5.1.6 Results and Discussion

Current River stations CR-1 and CR-2 were sampled thirteen times over the period June 1 to August 31, 1984. During this period, the fecal coliform daily geometric mean of the two stations was found to exceed 100 per 100 ml on only one occasion, August 7, 1984 (Underlined value in Table 10). This single 'pollution' event was directly associated with a heavy prolonged rainfall on August 6 and 7 (Figure 8). No additional samples were collected following heavy rainfall. However, it is probable that FC levels were also elevated at these stations on August 8, since elevated FC levels were recorded at station BLI-4 (just upstream of Boulevard Lake) on that date.

The Cascades Conservation Area is located only a short distance upstream of Boulevard Lake. In 1984, data generated at the beaches on this lake and the off-beach station BLI-4 were similar. Therefore, this data could be used in place of a routine monitoring program in the future.

5.2 RECOMMENDATIONS

1. Routine bacteriological monitoring of this area should be discontinued. This recommendation is advanced only on the understanding that station BLI-4 and the beaches at Boulevard Lake are routinely monitored. If these beaches are placarded, samples should also be collected at the Cascades to determine the water quality of that area.

6. NEEBING-MCINTYRE FLOODWAY

The Neebing-McIntyre Floodway is an artificial channel that runs through the City of Thunder Bay. In its upper reaches, this channel carries the water of the McIntyre River while in the lower reaches it carries the combined flow of the Neebing and the McIntyre Rivers.

6.1 NEEBING-McINTYRE "BEACH"

6.1.1 Background

On March 27, 1984, the Thunder Bay City Council ratified the following resolution: "THAT with respect to Report No. 123/84 (City Clerk), we recommend that the landscaped area on the north side of the Channel, between Balmoral and William Streets, be designated as a public swimming area, subject to the approval of the Thunder Bay District Health Unit." Although some preparation of a short section of the bank had been completed in 1983, the bacterial water quality of the proposed bathing area had not been adequately assessed throughout a summer period.

6.1.2 Description

The Neebing-McIntyre "Beach" is located on the Neebing-McIntyre Floodway upstream of Balmoral Street (Figure 15). The bathing area receives water only from the McIntyre River. The water is quite turbid and the bank muddy. The bathing area is directly in front of the graded section of the bank. The water depth in the bathing area increases very rapidly from shore.

6.1.3 Sanitary Survey

Only a very limited sanitary survey of the area near the beach was conducted on May 30, 1984. No outfalls

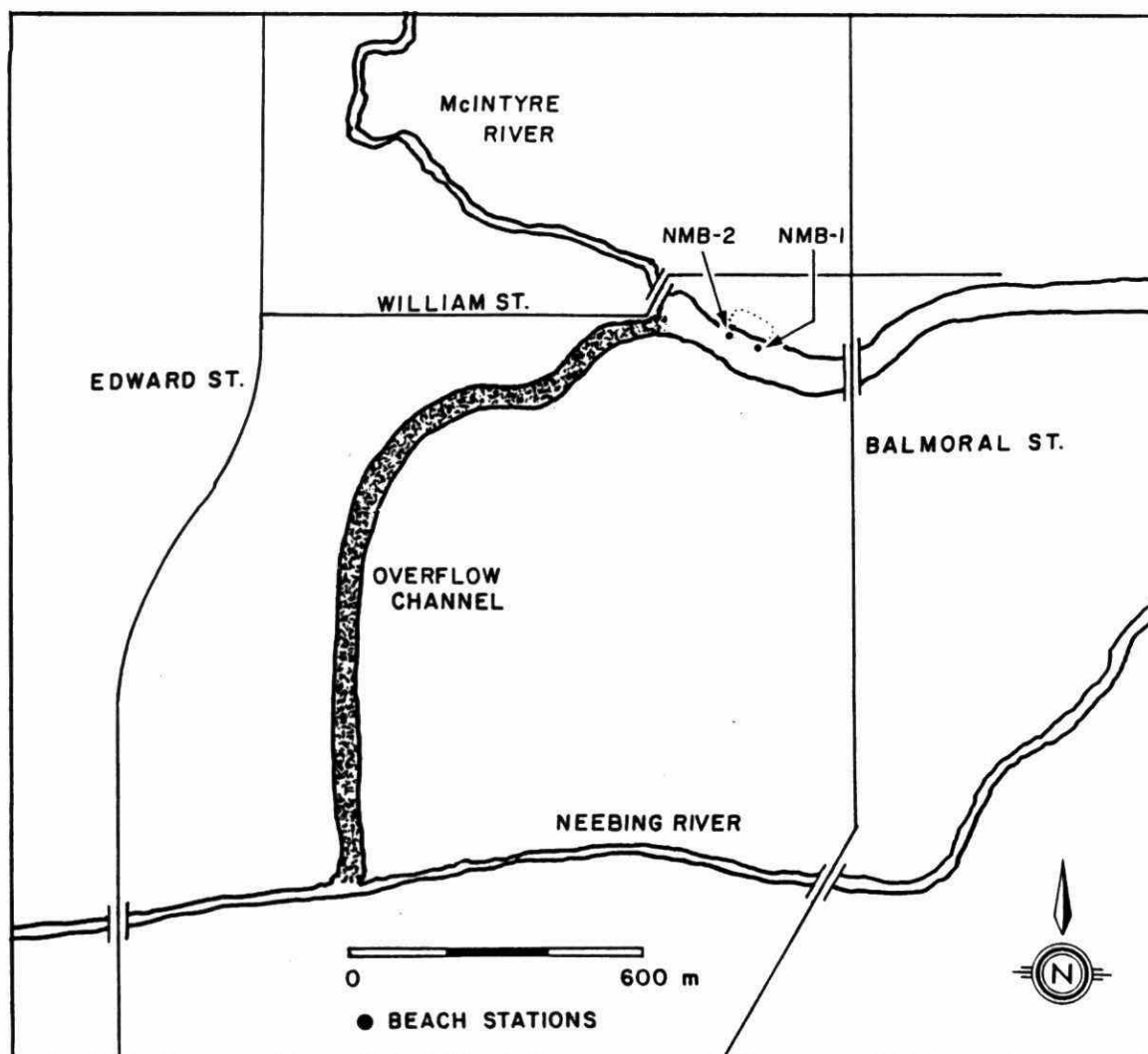


Figure 15. Neebing-McIntyre "Beach".

close to the beach were found. However, a number of private residences, Confederation College and Lakehead University lie only a short distance upstream.

6.1.4 Sampling Stations

Two sampling stations were established in the proposed bathing area: NMB-1 and NMB-2 (Figure 15).

6.1.5 Methods

All samples were collected on a weekday morning once per week throughout the summer. Until mid-July, all samples were analyzed for TC, FC, EC, FS and PSA. From mid-July until the end of August, samples were analyzed only for FC, EC and PSA.

6.1.6 Results and Discussion

Neebing-McIntyre 'Beach' stations NMB-1 and NMB-2 were sampled a total of fourteen times over the period May 30 to August 31, 1984. During this period, the fecal coliform daily geometric mean of the two station was found to exceed 100 per 100 ml on twelve occasions out of fourteen (Table 11). The fecal coliform seasonal geometric mean was 277 per 100 ml. Since this 'beach' was not a recognized bathing area and no bathers were observed, placarding was never considered throughout the summer of 1984.

In addition to the elevated FC levels, E.coli levels were also often greater than 100 per 100 ml. P.aeruginosa was present in 84% of the bathing area samples. PSA levels of 10 or more per 100 ml were found in 48% of the samples.

Very high levels (10^3 per 100 ml) of FC and E.coli were observed on June 13, June 27 and August 8. These intermittent high levels of bacterial contamination appeared to be directly associated with stormwater run-off

TABLE 11. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT NEEBING-McINTYRE "BEACH" (ALL DATA)							May 30/84 TO
							Aug 31/84
SAMPLING	FECAL COLIFORM COUNTS PER 100 ML					DAILY	
DATE	BEACH STATION NUMBERS					GEOM.	
YY MM DD	NMB1	NMB2				MEAN	
84 5 30	20	12				15.5	
84 6 6	340	480				404.0	
84 6 13	1500	1500				1500.0	
84 6 20	100					100.0	
84 6 27	3300	1300				2071.2	
84 7 4	120	90				103.9	
84 7 11	100	50				70.7	
84 7 18	290	290				290.0	
84 7 25	160	100				126.5	
84 8 1	210	270				238.1	
84 8 8	1400	2300				1794.4	
84 8 15	1500	250				612.4	
84 8 22	570	560				565.0	
84 8 29	430	590				503.7	
GEOM. MEAN							332.61 223.01

since these samples were collected within 72 hours of a major rainfall (Figure 1 and 2). The exact source of these fecal bacteria observed in the bathing area is unknown. However, both the agricultural lands and stormwater outfalls upstream may have contributed to these elevated bacterial levels.

The McIntyre River appeared quite susceptible to stormwater run-off. Bacterial loadings under dry weather conditions were difficult to determine since the length of time that a given rainfall influenced the water quality was unknown.

The appropriateness of establishing a bathing beach in this area on the Neebing-McIntyre Floodway is questioned. In addition to the intermittent bacterial problems, the bathing area is not aesthetically pleasing due to its turbid water, steep muddy banks and growths of water plants.

6.2 110TH AVENUE BRIDGE 'SWIMMING' AREA

6.2.1 Background

It was reported that the Neebing-McIntyre Floodway at the 110th Avenue bridge is a local swimming area. However, it is not a recognized public bathing area. The extent to which the area is used for swimming is unknown. This site was included in the 1984 monitoring program as it provided a comparison to the other bathing areas near Thunder Bay. Only limited bacteriological data was available for this location.

6.2.2 Description

The 110th Avenue bridge 'swimming' area is located within the City of Thunder Bay on the Neebing-McIntyre Floodway at the 110th Avenue bridge (Figure 16). At this point, the floodway carries the combined flow of both the Neebing and the McIntyre Rivers. The water flows very sluggishly at this location in the summer and is usually quite turbid.

6.2.3 Sanitary Survey

Only a very limited sanitary survey of the area was conducted prior to the bathing season. No outfalls were observed close to this swimming area. Nevertheless, as the two rivers flow through the city, numerous outfalls empty into the rivers upstream of the 110th Avenue bridge.

6.2.4 Sampling Stations

Two sampling stations were established at this swimming area: 110-1 and 110-2. Both stations were located just downstream of the 110th Avenue bridge on either side of floodway, approximately 2 m from shore.

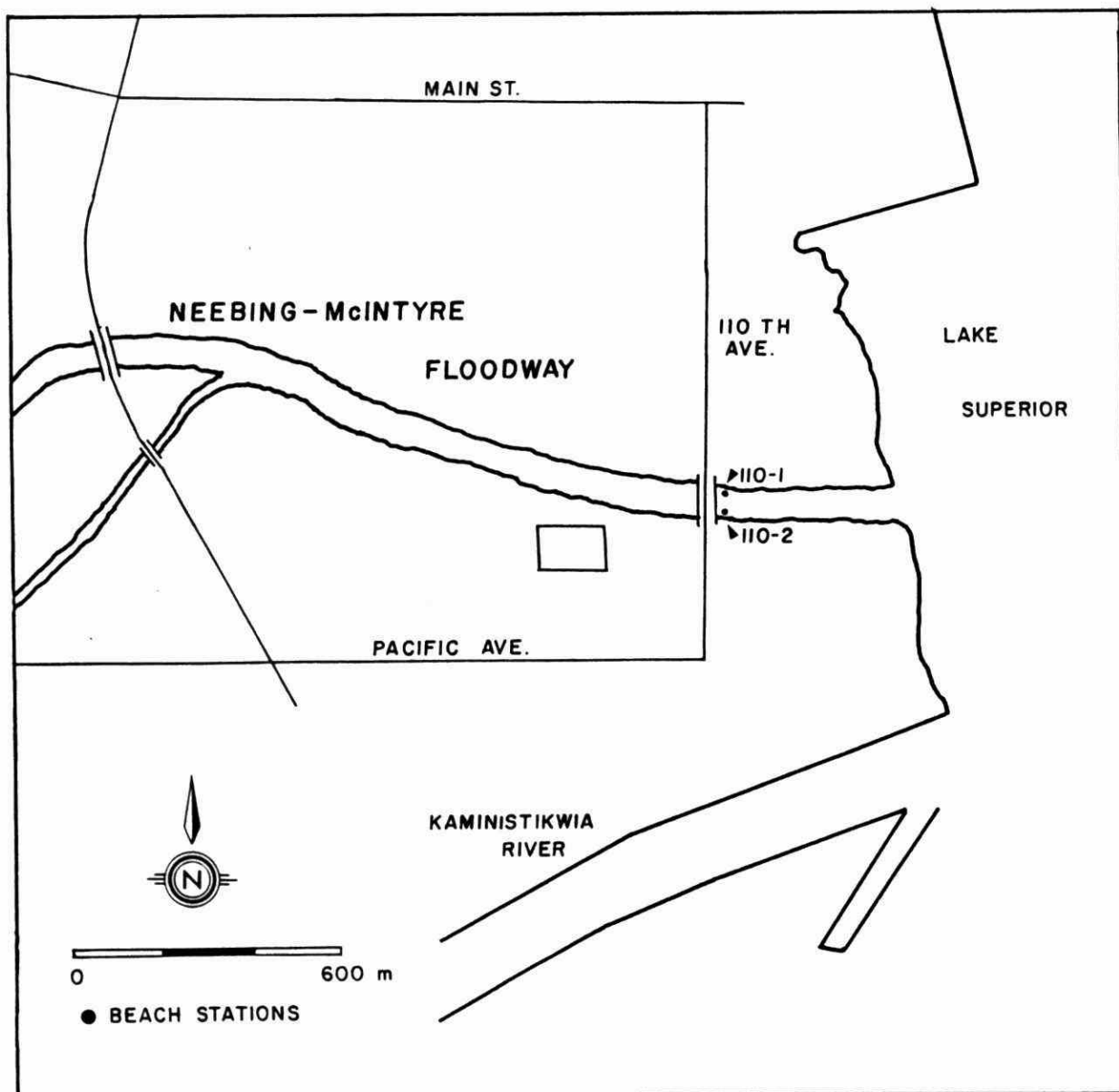


Figure 16. 110th Avenue Bridge 'Swimming' Area.

6.2.5 Methods

All samples were collected on a weekday morning each week throughout the summer. Until mid-July, all samples were analyzed for TC, FC, EC, FS and PSA. From mid-July until the end of August, samples were analyzed only for FC, EC and PSA.

TABLE 12. GEOMETRIC MEAN FECAL COLIFORM LEVELS AT 110TH AVENUE BRIDGE SWIMMING AREA (ALL DATA)							May 30/84 TO Aug 31/84
SAMPLING DATE YY MM DD	FECAL COLIFORM COUNTS PER 100 ML BEACH STATION NUMBERS					DAILY GEOM. MEAN	
	1101	1102					
84 5 30	10	40				20.0	
84 6 6	190	280				230.7	
84 6 13	1500	1500				1500.0	
84 6 20	80	80				80.0	
84 6 27	9700	10700				10187.7	
84 7 4	420	140				242.5	
84 7 11	40	20				28.3	
84 7 18	160	170				164.9	
84 7 25	240	200				219.1	
84 8 1	50	10				22.4	
84 8 8	2100	3000				2510.0	
84 8 15	30	60				42.4	
84 8 22	170	150				159.7	
84 8 29	70	100				83.7	
GEOM. MEAN	184.6	179.8					

6.2.6 Results and Discussion

The 110th Avenue 'swimming' area stations 110-1 and 110-2 were sampled a total of fourteen times over the period May 30 to August 31, 1984. During this period, the fecal coliform daily geometric mean of the two stations were found to exceed 100 per 100 ml on eight occasions out of fourteen (underlined values in Table 12). The fecal coliform seasonal geometric mean was 181 per 100 ml. Since this 'swimming' area was not a recognized public bathing beach, placarding was never considered.

The fecal coliform daily geometric mean ranged from 20 to 10,187 per 100 ml. E.coli levels ranged from 10 to more than 7000. P.aeruginosa was present in 80% of the bathing area samples. PSA levels ranged from less than 1 to 114 per 100 ml. PSA was present at a level equal to or greater than 10 per 100 ml in 52% of the samples analyzed.

Three very high levels (10^3 per 100 ml) of FC and E.coli were recorded on June 13, June 27 and August 8. These intermittent high levels of bacterial contamination appeared to be directly associated with stormwater run-off. On these dates, samples were collected within 72 hours of a heavy rainfall (Figure 1 and 2). The three dates are identical to those on which high levels of FC and E.coli were observed upstream at the Neebing-McIntyre "Beach". This illustrated that high levels of fecal bacteria extended throughout the entire length of the Floodway.

6.3 RECOMMENDATIONS

1. The establishment of a bathing area at the Neebing-McIntyre "Beach" is not recommended.

GENERAL DISCUSSION AND CONCLUSIONS

During the summer of 1983, the bathing areas at three beaches close to the City of Thunder Bay: Chippewa Beach, Lakeview Beach and Hazelwood Beach, were placarded for the first time. This action was taken by the Thunder Bay Medical Officer of Health as a result of finding fecal coliform bacterial levels that exceeded the Provincial guideline. The erection of placards at a beach indicates "that the water quality in a particular area is hazardous to bathers and that they bathe only at their own risk" (4).

In 1984, Chippewa Beach was the only bathing area in the Thunder Bay District that was placarded. The reduction in the number of placarded beaches, reflected a reduction in the levels of fecal bacteria found at these beaches in 1984. This reduction can be attributed partially to three differences between the 1983 and the 1984 bathing season.

1. In 1983, warmer summer temperatures produced warmer water temperatures over a longer period of time than in 1984.
2. In 1983, warmer summer temperatures probably increased both the number of bathers and the length of time that each beach was used.
3. In 1983, water samples were collected close to the shoreline of the bathing area by an individual standing on the shore and extending a sample bottle held by a rod into the water. In 1984, water samples were collected by an individual wading out into the bathing area and sampling at a beach station which was located in 1-1.5 m of water.

Each of these factors may have contributed to a reduction in the levels of bacteria observed in the 1984 beach samples. In 1984, except for one occasion, the bacteriological water quality of Lakeview Beach was found to be very good (using FC as the sole criterion). Multiple instances of high FC levels were not observed as in 1983. Similarly, at Hazelwood Beach, the seasonal water quality was also very good.

However, the fecal coliform daily geometric mean was exceeded on three occasions. These occurred only during heavy bather loading - a factor that did not exist the previous year.

The two 'swimming' areas monitored on the Neebing-McIntyre Floodway both had numerous instances of impaired bacteriological water quality in 1984. It is not recommended that these two areas, and indeed, the entire length of the floodway, be used for bathing due to the high levels of fecal bacteria observed. The fecal coliform seasonal geometric means of both areas were over 100 FC per 100 ml.

Heavy rainfall and its attendant stormwater run-off was the prime contributor to 'pollution' events at certain beaches. In most cases, the exact source of the fecal contaminants in the stormwater could not be determined. Therefore, this problem is expected to continue. Chippewa Beach and Chippewa Campground Beach appeared particularly susceptible to contamination from stormwater run-off. Lakeview Beach and Sandy Cove Beach were affected only when the rainfall was prolonged and heavy. Sunnyside Beach and Hazelwood Beach were not adversely affected by stormwater run-off in 1984. Since all of the beaches were not affected to the same degree by the same factors, it is extremely important in any beach monitoring program, that samples are collected under a variety of conditions so that the impact of the various factors can be assessed. Each beach must be individually evaluated.

The presence and activity of bathers can lead to elevated levels of bacteria in the water of the bathing area. Increased levels of bacteria were observed at Hazelwood Beach when large numbers of children used a very small bathing area. The differences noted in the bacteriological water quality at this beach between morning and afternoon sample results show that sample collection when bathers are present is extremely important to properly assess the water quality. However, the effect of bather loading was not perceptible at any of the other beaches, although PSA was consistently isolated at each of the beaches at Boulevard Lake Park.

GENERAL RECOMMENDATIONS

1. Stormwater run-off caused by heavy rainfall was the primary factor affecting the water quality of the bathing area at a number of the local beaches. The amount of rainfall required to cause a 'pollution' event should be confirmed during a second bathing season to determine whether or not the amounts found in 1984 remain constant at a given beach.
2. On-site rain gauging equipment is required to accurately monitor the amount of rain falling at each park since small localized storms may drop substantially different amounts of rain at each park.
3. The bathing area at Hazelwood Beach is too small to adequately accomodate the day-camp program. This program should be moved to a beach with a larger bathing facility. However, the beach selected in 1985 should be closely monitored for a bather loading effect.
4. The beaches at Boulevard Lake Park should be monitored for the P.aeruginosa during a second bathing season to determine whether or not this organism is consistently found in the bathing areas at this lake.
5. The mechanism by which stormwater run-off affected the water quality of the bathing area at Chippewa Beach was not completely elucidated. It is recommended that this aspect be investigated further.

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